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WOOD

LUMBER AND TIMBERS

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CHANDLER CYCLOPEDIA

FOR THE SCIENTIFIC SELECTION, PURCHASE, AND USE OF COMMODITIES

VOLUME 1

WOOD

LUMBER AND TIMBERS

by

PHILLIPS A. HAYWARD

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DEDICATED

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As publisher of the Chandler Cyclopedia I feel a glow of anticipatory pride in contemplating the men at work on the various issues. Each knows his subject, each has ability, and each comprehends the opportunity for service offered him to aid you in the scientific selection, purchase, and use of the best available commodities for your specific purposes. The entire purpose of the cyclopedia is to help the buyer, the architect, the engineer, everyone who is interested in the wise choice of commodities. Therefore, each issue will contain some original material as well as some chosen from standard reference sources.

The author and editor of this volume is PHILLIPS A. HAYWARD, Bachelor of Science in Forestry and Master of Science in Wood Technology.

Mr. Hayward's experience has combined theory and practice. He owned and operated a lumber mill for several years, acted as wood preservation specialist to the Chicago, Burlington & Quincy Railroad, served as a lumber inspector, was instructor in Wood Utilization at the New York College of Forestry—and for two years was a hardwood lumber and log buyer. At present he is the Wood Utilization Counselor of the National Committee on Wood Utilization—U. S. Department of Commerce. His work has included the writing and compiling of numerous published articles on wood—and few people ever meet such a variety of problems on wood utilization as constitute his regular activity.

W. L. CHANDLER,
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The publisher desires to thank the many friends who gave encouragement and counsel in the creation of Datalog and its expansion into the Chandler Cyclopedia.

PREFACE

Wood is one of our most important materials, yet it is not understood and appreciated by many. It has played a vital part in the industrial progress of this country. Each day valuable information is produced regarding its properties and possible uses.

This volume on wood has been developed to furnish consumers and fabricators of wood and allied products with data which will assist them in the simplification of lumber purchasing. This publication is not technical in any sense of the word. It is not intended as a manual, but simply as a guide in pointing out the "high lights" regarding some of the important fundamental properties of wood. Ample references have been included which can be consulted for additional information.

Practical and authoritative data developed from technical research is constantly required by the industrial leaders of today, and books of ready reference are short cuts to this information.

It is sincerely hoped that the data given in this publication will prove valuable as an aid in the purchasing and use of lumber. An effort has been made to present in detail solutions to those problems which daily confront the consumer in his attempt to utilize wood for specified purposes.

The lumber industry is fortunate in having a world of printed material concerning the properties of and uses for wood.

Government departments have been of great assistance in furnishing data which were of special value in developing the information included in this publication. Grateful acknowledgment is made by the author to the Forest Products Laboratory of the Forest Service, United States Department of Agriculture, for reports and printed matter; to the Forest Service of the United States Department of Agriculture, for information on nomenclature of the various species of trees; to the Bureau of the Census, United States Department of Commerce, for figures on lumber production; and to the Division of Simplified Practice of the Bureau of Standards and the National Committee on Wood Utilization, both of the United States Department of Commerce, for information regarding lumber standardization and wood utilization.

The author also wishes to thank the National Lumber Manufacturers Association and its regional associations for valuable information regarding the various species of wood; the National Hardwood Lumber Association for data on hardwood grades; and the Hardwood Manufacturers Institute for shipping weights of hardwood lumber and statistics on hardwood production.

Of special interest is the discussion on small dimension contributed by Claude C. Bell, of the National Committee on Wood Utilization.

PHILLIPS A. HAYWARD.

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Scientific Name	Principal States Producing Cut	Uses
Annual Production	Range of Species	Classifications
Average Value of Lumber Cut at Mill	Usual Name	Types and Sizes
	Also Called	Unit Packages

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INTRODUCTION

Why Use Wood?

Wood combines strength and stiffness with lightness. Weight for weight, some woods are stronger than steel. Compared to other materials wood offers remarkable resilience and shock-resisting ability. The many properties of wood render it ideal for fabrication.

Ten years ago wood had some two thousand uses; today there are four thousand or more uses for this material.

Industry demands wood. In short, wood has been and always will be in demand for purposes where its use is economically sound.

This is What Wood Offers

Wood is available in qualities and quantities, grades and sizes, to supply the demands made by consumers and fabricators. Wood is easily accessible. It can be machined, sawed, carved, planed, or turned to any pattern or shape.

Wood can be bent or twisted.

It can be easily fastened together with nails, screws, dowels, joints, and glue.

Wood has beauty of grain, color, and texture.

Wood can be sawed and can be sliced into thin sheets of veneer.

It is capable of taking and holding well finishes, stains, and paints.

Wood is an insulator of sound and heat.

Its coefficient of expansion and contraction is small.

It does not rust or corrode.

Defects in wood are usually evident on its surfaces.

Wood can be easily transported.

When dry, wood is a nonconductor of electricity.

Wood is produced from a renewable natural resource.

Wood generally fails slowly under load, and gives a warning.

WOOD

LUMBER AND TIMBERS

WOOD STRUCTURE

The complexities of wood structure control the use of wood. Unfortunately, the lack of definite knowledge regarding the properties of wood has caused wood to be used for certain purposes where it is not economically sound. Research and study by the Forest Products Laboratory, Madison, Wisconsin, lumber associations, colleges, and individuals have led the way to many established facts which are of inestimable value to the consumer and the fabricator of wood.

The structure of wood varies. No two pieces of wood are identical. Grain, figure, color, and mechanical properties are different, not only between species, but within the same species.

Many factors contribute to variations within the wood structure: namely, growth, site, soils, infiltraceous materials, etc.

The properties of wood depend upon its chemical and physical structure. Fundamentally, the chemical structure is the same in all woods, and is composed of the same elements, but the physical structure (how the wood is built up) varies greatly and is responsible for differences in the properties of the various species of woods.

Wood, like other plant materials, is composed of tubular fiber units or cells cemented together. Practically half of the volume of wood is occupied by cell cavities. This structure is responsible for the many possible uses for wood, and is the outstanding reason why wood, weight for weight, is as strong as, if not stronger, than any other material.

Physical Properties of Wood

The physical properties of wood are those which are apparent without subjecting the wood to any chemical action. Examples of these properties are: grain and texture, color and luster, absorption of moisture, weight, shrinkage and swelling, odor, taste, workability, durability, gluing, and seasoning characteristics.

Mechanical Properties of Wood

Mechanical properties of wood pertain specifically to its strength. Strength may be expressed in numerous ways, but for practical purposes it pertains especially to: strength in compression, tensile strength, shearing strength, cross-breaking strength, stiffness, shock-resisting ability, hardness, cleavability, and plasticity.

As mentioned above, strength of wood is interpreted in several different ways, and may have a variety of meanings, all of which depend upon the use intended. Strength in compression refers to the use of wood for columns and posts in buildings. In structural beams cross-breaking strength (or bending strength) is looked for. In wood used for ax handles, both toughness (shock-resisting ability) and hardness are generally included in the term "strength."

It can be seen that strength may include several properties, or it may consist of a single property, according to the use to which the wood is to be put, and that in comparing woods the property or properties must be specified.

No two pieces of wood have the same identical strength value. This is quite apparent, due to the complexities of wood structure, defects, etc. The Forest Products Laboratory, through a series of tests on the strength of common American woods, has developed the following facts regarding the strength of wood:

The strength of various species of wood varies in general as their specific gravity or their dry weight. Some species, however, have individual characteristics which at times cause wide deviation from this rule. Dry weight is a measure of the strength of individual pieces of any one species.

Each annual growth ring is made up of a comparatively heavy narrow band of summer wood and a lighter wide band of spring wood. The greater the proportion of summer wood, the greater the weight and strength of the timber.

No differences in mechanical properties due to a change from sapwood to heartwood have been found. As a tree grows the sapwood is continually changing into heartwood and new sapwood is continually being added to its circumference. All the heartwood in a mature tree was at one time sapwood. If a tree is cut at a time when it is forming its densest wood so that this dense wood is still sapwood, pieces cut from the sapwood will be the stronger. If, on the other hand, it is cut at a time when the wood being formed as sapwood is not so dense and the denser wood has changed to heartwood, then pieces cut from heartwood will be stronger.

Exceedingly rapid or slow growth in conifers, such as the southern pines and Douglas fir, has usually been found to be attended by light weight and inferior mechanical properties. In the case of hardwoods, such as hickory and ash, fast-grown wood with few annual rings to the inch is generally stronger and heavier than wood of slow growth.

The effect of the locality in which trees grow on the nature of the timber produced is very complex. Variations in strength properties of the wood of a certain species attributed to difference in locality of growth are frequently exaggerated. For a single species there is likely to be a greater difference in strength between the wood of trees grown in the same locality than between the average strength of material from different regions.

Trees growing close together and apparently under the same conditions occasionally show a difference in their mechanical properties that cannot be entirely accounted for by the difference in density. Whether this difference is due to the ancestry of the tree or to some other cause, such as soil conditions, is not yet known.

The strength of small, clear pieces is greatly increased by seasoning. In large timbers, the increased strength attending a loss of moisture in drying is mostly offset by checks and other defects developed during the seasoning process. Therefore, in large members, it is not considered advisable to anticipate any added strength due to seasoning.

Classifications of Wood

Inasmuch as the cell is the unit for wood classification, the basis for separation of woody structure into species depends upon the properties and combination of these cell units. (See Plate I.)

The cells in wood vary in size and shape, and the functions which they perform. Collectively, they are known as elements.

The most striking elements of wood are:

Fibers	Wood rays	Parenchyma
Pores	Resin ducts	

Fibers

Wood fibers are long, narrow, tapering cells closed at the ends. In hardwoods they are smaller than in softwoods.

Pores

Pores are found only in hardwoods, and are scattered among the fibers. They are cells which are comparatively large in diameter as compared to the fibers, are open at both ends, and are set one on top of the other arranged vertically in the tree, forming continuous tubes (pores).

Wood Rays

Wood rays are made up of a combination of various cells, and are quite conspicuous in certain trees (oaks, sycamores, etc.). They are apparent as lines extending radially from the center of the tree to the bark when viewed in a cross-section surface, and as flecks or blotches on "quartered" surfaces. (See Plate III.)

Resin Ducts

Resin ducts found in some of the softwoods (conifers) are special intercellular units for storing and conducting resins. They are found in pines, spruces, larch, tamarack, and Douglas fir.

Parenchyma

Parenchyma is an important element of wood structure and occurs:

Vertically in the form of scattered rows of cells (wood parenchyma), visible in cross-section as small cells

Horizontally, as plates of cells in the wood rays (ray parenchyma)

True wood parenchyma cells are subject to wide variations in distribution and arrangement. In cross-section the parenchyma cells appear:

Scattered irregularly through the growth ring

Arranged in tangential lines or bands

Terminally, forming outer limits of the growth ring

Surrounds pores

Arranged in radial rows

In the softwoods, wood parenchyma occurs quite as found in the hardwoods (terminally, scattered or zoned). In the hardwoods, the occurrence of parenchyma is an important means of identification.

Porous and Nonporous Wood

Variation in cell arrangement and formation in wood is the basis for separating and identifying the different kinds of wood.

Two distinct types of wood divisions have been established: namely, porous and nonporous.

When viewed in cross-section, woods in which large openings are apparent are *porous woods;* those in which they are lacking are *nonporous.* (See Plates II and IV–A.)

For some reason nature has made variations within the structure of porous woods. If all the pores are approximately the same size and are scattered throughout the annual rings the wood is called diffuse-porous (red gum, maple, beech, etc.). (See Plate IV–B.) In other species of woods very large pores develop early in the growing season of the wood, while only small pores or none at all appear later. A cross-section of such a wood exhibits concentric rows of large pores alternating with dense portions of small pores, creating definite rings or zonings. Such woods are called ring-porous (see Plate IV–C) and are best exemplified by the oaks, hickories, elms, etc.

Annual Rings

Climatic conditions, in a sense, have a direct bearing upon the growth of a tree. In warm climates and in the tropics growth is sometimes continuous and new cells are constantly being added to the wood without any apparent change in the tree's growth.

In the temperate zones, where a marked contrast of seasonal period is prevalent, trees are dormant during certain months of the year. The wood cells produced in the spring of the year next to the bark are usually *larger* than those produced later in the growing season. This variation is the cause of a sharp line of demarcation between the last cells formed in one year's growth and the first cells formed the next spring. This line of demarcation between one year's growth and the next is spoken of as the *annual ring.*

The width of the annual ring varies according to the growth of the tree.

Springwood and Summerwood

Growth which begins in the spring produces cells which are generally comparatively large and thin-walled, resulting in wood which is light, soft, and weak. This formation is spoken of as springwood. Later, as the season advances, growth slows down and the cells are smaller and thicker-walled, and form a darker, harder, and stronger layer, known as the summerwood. The amounts of springwood and summerwood produced by a tree during a period of years vary, and inasmuch as the springwood is weaker than the summerwood, the latter is responsible for the *strength* of the wood.

In some species (larch, longleaved pine, etc.) the change from springwood to summer wood is quite abrupt. (See Plate V.) In white pine, spruce, the maples, etc., the change is more gradual and the cells decrease only slightly in size during the entire growing season. This results in a less sharply defined zoning between the springwood and summerwood growth.

Sapwood and Heartwood

Sapwood is the outer, living portion of the wood in a tree; the inner, matured portion is heartwood. The color and amount of sapwood and heartwood vary in the different species. (See Illustration 1.)

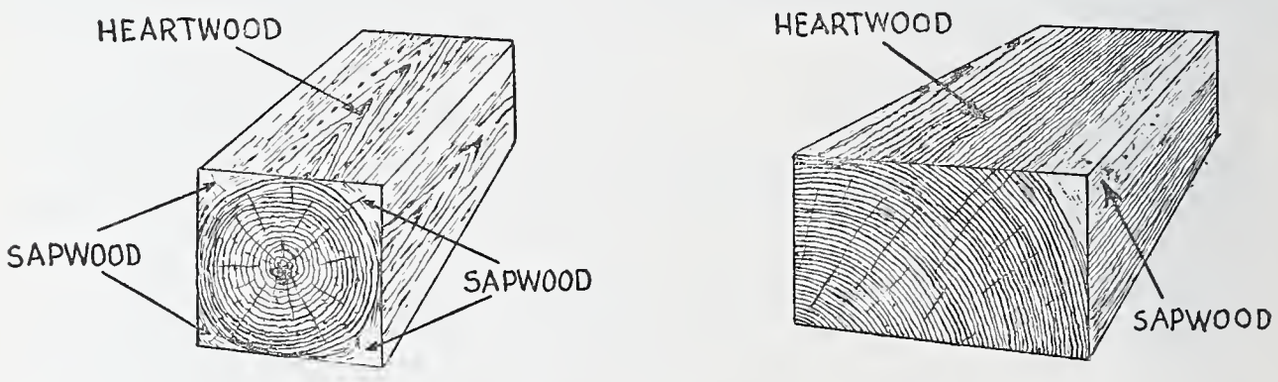
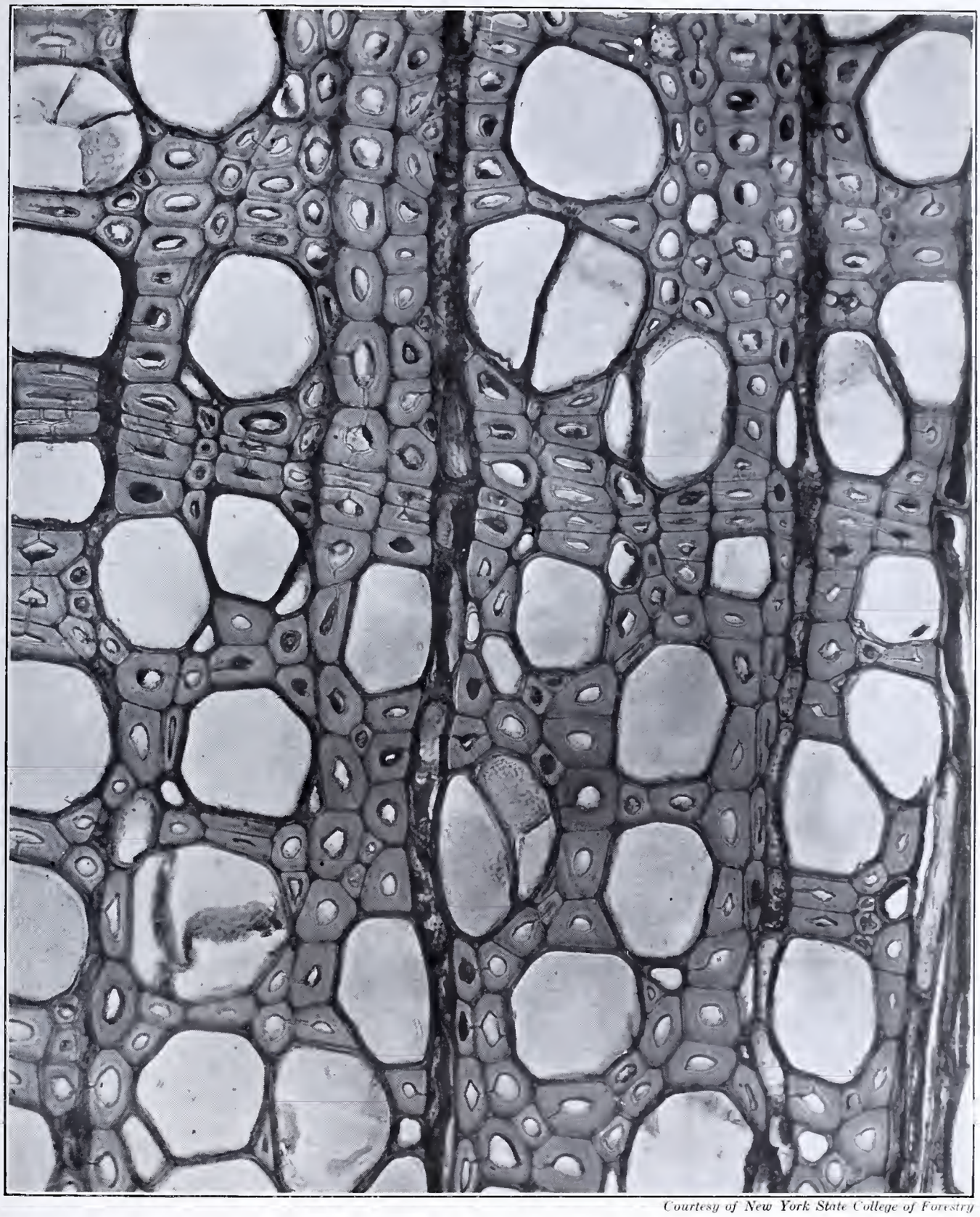


Illustration 1—Sapwood and heartwood in wood.

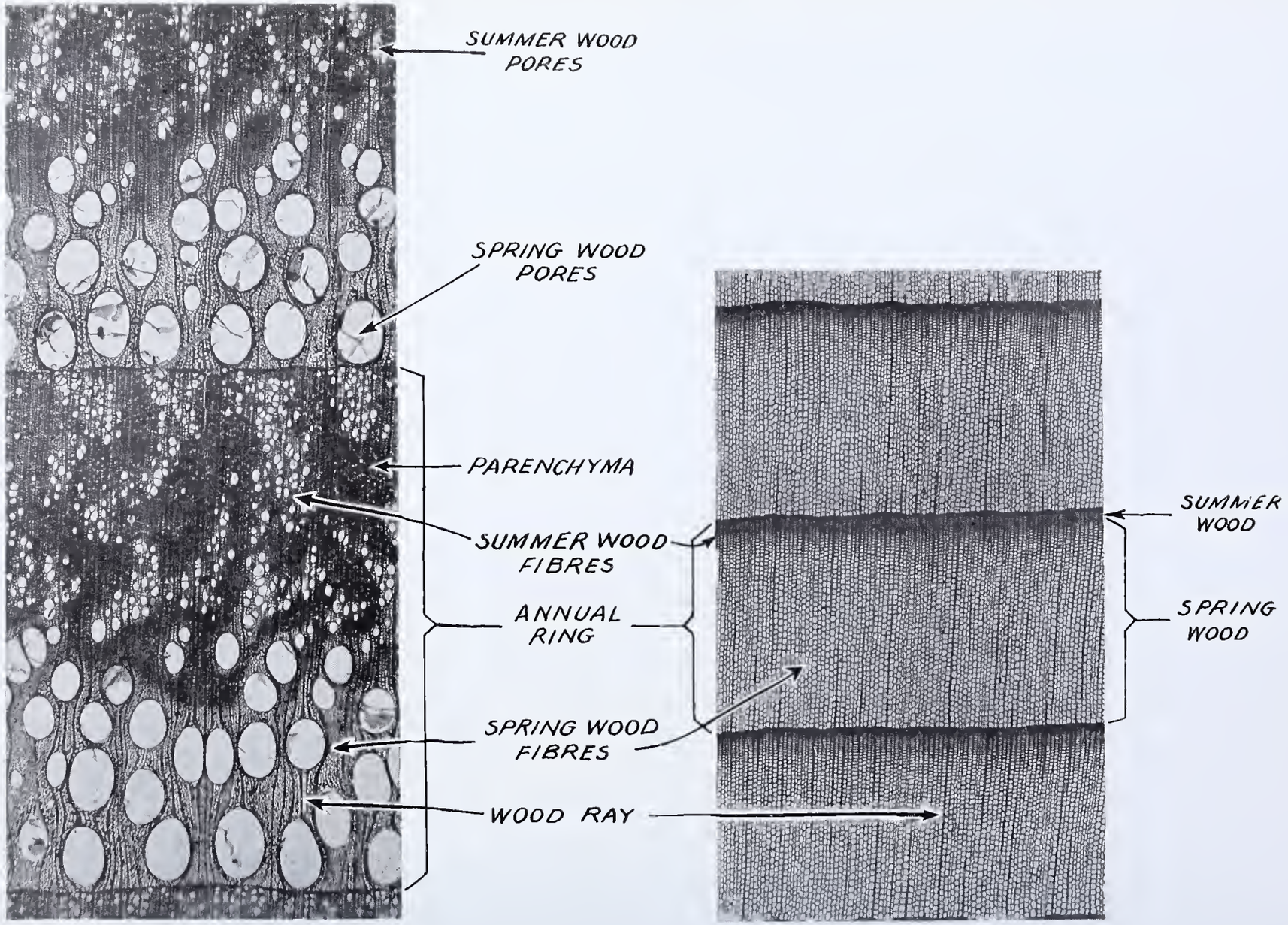
Sapwood, contrary to belief, is not stronger than heartwood, or vice versa. Tests of clear sections of sapwood and heartwood, of equal moisture content, have proved that they have equal strength values.

Heartwood, as a general rule, is more durable than sapwood and less susceptible to decay and stain.



Courtesy of New York State College of Forestry

Plate I—"The complexities of wood structure control the use of wood." A highly-magnified (350 times) cross-section of red gum. The large thin-walled elements are the pores (vessels); the thick-walled, smaller elements are fibers (fiber tracheids). Note that tiny openings, known as "pits," lead from one cell to another and are quite noticeable in the fiber walls. The wood rays appear as heavy black lines extending perpendicularly across the picture. If carefully examined, a group of fibers extending left to right about midway in the picture will be seen, forming the annual ring. The variations in size, arrangement, and occurrence of the elements of wood, with other factors, control its many uses



Courtesy of Forest Products Laboratory

Plate II—Variations in wood structure in porous and nonporous woods.
A. Cross-section view of chestnut (porous wood).
B. Cross-section of redwood (nonporous wood).

There is no striking difference in the size and arrangement of the elements of wood as formed in heartwood and in sapwood. All heartwood was once sapwood and as the tree grew the sapwood gradually turned into heartwood. The cells in heartwood simply cease to exist as active living cells and become inactive and matured wood.

Grain and Texture

Unfortunately, in the trade, the terms "grain" and "texture" have been used loosely and this has led to apparent inconsistencies in their use. (See Plate VI.)

For practical purposes, grain refers to the alignment and arrangement of cells.

Texture has to do with the size and distribution of the cells.

Grain is influenced by three dominant factors: (1) the character of the annual ring; (2) the natural direction of wood fibers, pores, etc., in relation to the axis of the tree; and (3) mechanical variations in manufacture.

Fine Grain and Coarse Grain

Grain is spoken of as either fine grain or coarse grain.

Woods with wide growth rings are often referred to as coarse grained, such as chestnut, ash, and oak. Narrow ring growth results in a fine grained wood, such as white pine, maple, etc.

Even and Uneven Grain

Even grained wood is that in which there is little contrast between the springwood and summerwood (spruce, white pine). Where the summerwood is pronounced (as in Douglas fir, oak, elm, etc.) the grain is known as uneven.

Smooth Grain and Rough Grain (Woolly)

Smooth or rough grain refers to the surface appearance of the wood after finishing. Such grains are the result of variation in the character and direction of the wood elements. Woolly grain results when the fibers of the wood tend to lift and fray during surfacing.

Straight Grain and Cross Grain (Spiral)

In straight grain the fibers run straight up and down the tree, while in cross-grained wood the fibers extend diagonally across or ascend in spirals. Lumber cut from such trees appears as cross grain. Careless sawing of a log may produce cross-grained lumber from a structurally straight grained tree.

Curly, Interlocked, and Wavy Grain

Curly grain is commonly caused by an irregular distortion of the various fibers in the wood.

Interlocked grain is caused by variations in the spiral arrangement of the fibers in the tree. Such changes in alignment generally occur in the tree every three to five years. Interlocked grain is quite common in our tropical woods and in a few of our own species. An interlocked-grain wood when quarter-sawed produces a "ribbon stripe" effect on its surface.

Wavy grain (fiddle back) is due to the wavy arrangement of the fibers (mahogany, etc.).

Landscaped and Mottled Grain

Landscaped grain refers to odd and shapely figures formed in curly grain.

Mottled grain is caused by variations in the arrangement of the fibers which produce a mottled appearance of the wood.

Bird's-Eye Grain

Bird's-eye grain is caused by dips and depressions of the annual rings, the exact reason for which is not known. A depression made in one ring continues the contour in succeeding growth rings for many years. It is common in certain woods (bird's-eye maple, also in some spruces and redwoods).

Silver Grain

Silver grain refers to the wood rays produced in quartering wood. In oak and sycamore the wood ray is quite evident and pronounced.

Burls

Burls appear in the wood surface as small, tiny, or groups of knots. The cause of their occurrence is not known. Burls are desired in certain woods, such as black walnut, redwood, cherry, etc., because of the beautiful figure produced.

Edge Grain, Quarter Grain, Vertical Grain, Comb Grain, and Rift Grain

These five terms are used to describe lumber sawed parallel to the radii of the log.

Flat Grain (Plain)

Flat grain refers to grain produced on a tangential or plain-sawed board. (See Quarter-Sawed and Plain-Sawed Stock.)

Texture

Texture refers to the size and distribution of the cells of which wood is composed. It is referred to as fine, coarse, uniform, nonuniform, even, and uneven.

Fine texture refers to wood structure composed of small cells.

In coarse texture the cells are large in size.

In uniform texture the cells are fairly uniform in size.

In nonuniform texture the cells are strikingly varied in size.

In even texture the elements (cells) are evenly distributed in each annual ring of growth.

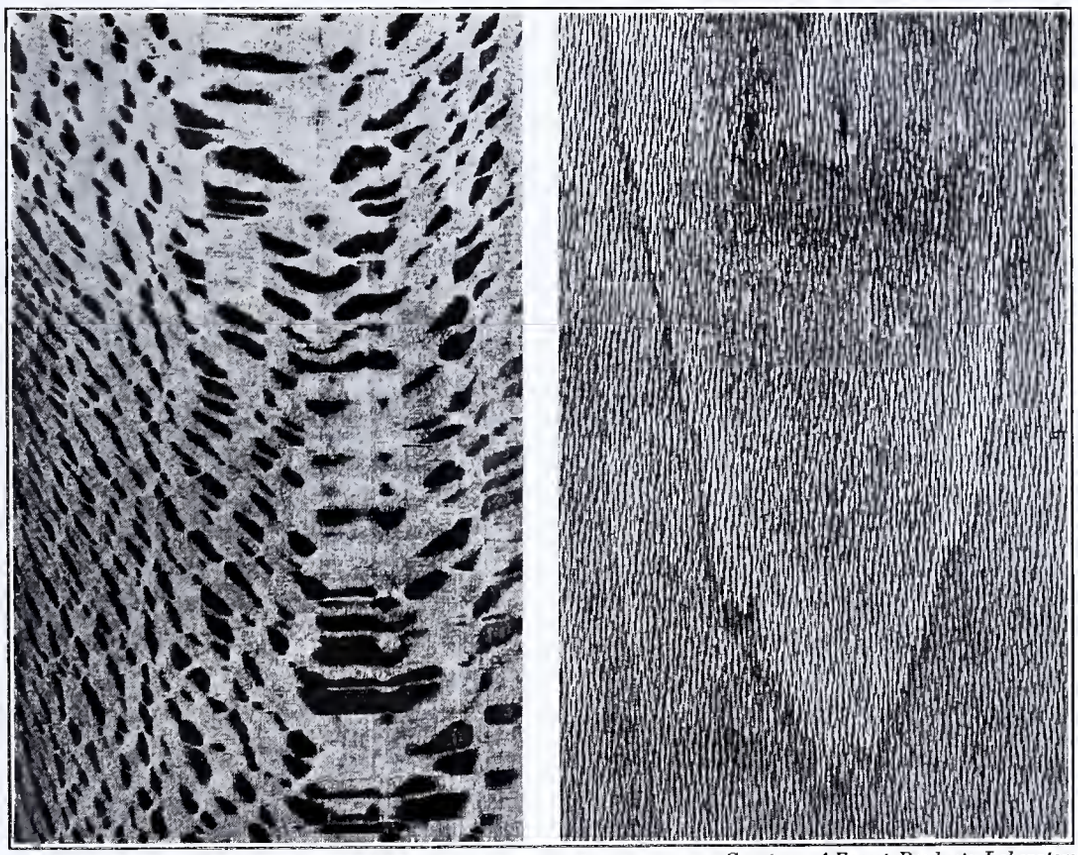
In uneven texture there is a wide variation in the distribution of the elements in the annual ring.

Soft Texture

"Soft texture" is a trade name often applied to certain woods, particularly the oaks, poplar, ash, white pines, spruces, and other species. In a sense this term applies more specifically to the working qualities of the wood, rather than to variations in hardness and softness. The term "soft texture" implies a combination of mechanical, physical, and chemical properties which produce working qualities and figure that are much favored in the trade.

The term is applied to certain Appalachian hardwoods which are noted for the above-mentioned characteristics, the lumber of which is referred to as soft-textured Appalachian white oak, red oak, poplar, etc.

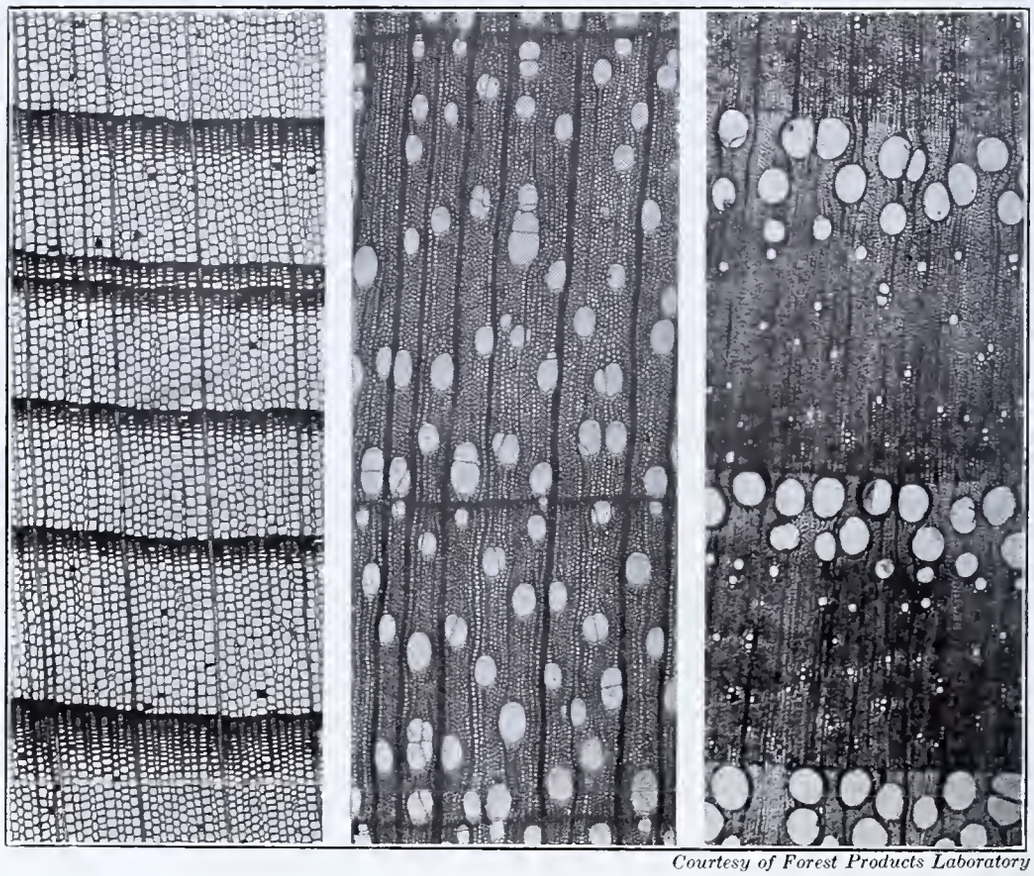
Additional information regarding these woods and their properties can be secured from the Appalachian Hardwood Club and other regional associations.



Courtesy of Forest Products Laboratory

A B

Plate III—A. Quarter-sawed surface of sycamore, showing radial view of wood rays. B. Plain-sawed (tangential) surface of sycamore. Note that in this view the wood rays appear as fine black lines. Magnified about 7½ times.



Courtesy of Forest Products Laboratory

A B C

Plate IV—A. Cross-section view of a nonporous wood (western larch—a softwood). B. Cross-section of a diffuse-porous wood (yellow birch—a hardwood). C. Cross-section of a ring-porous wood (chestnut—a hardwood). All sections magnified about 20 times.

Figure in Wood

Figure in wood, which is highly prized for many purposes, is largely due to the following factors:

Difference in the size and arrangement of the various cells
Distortion in the alignment of the fibers
Irregularities in the formation of pigments in the wood
Infiltrateous materials
Variations in the size and character of the annual rings
Occurrence and size of wood rays
(See Plate VII)

The words "figure" and "grain" approximate each other closely in meaning, and often in the trade they are used interchangeably.

It should be borne in mind that figure is a final result of many factors regarding the elements and structure of wood, while grain more specifically limits the variation to a type or kind of grain which is apparent in the various figures of wood.

Figure, moreover, refers to the beauty and general appearance of wood, and in reality is due to the variation in the wood structure.

Peckyness

Peckyness in wood, often referred to as peck, is found only in a very few species of wood—most commonly, cypress and western red cedar.

In the trade, lumber which contains peck is frequently quoted as "sound peck," "pecky cypress," or, in a special grade of common lumber, as "peck."

In reality, peckyness is a form of decay caused by wood-destroying fungus which occurs in the tree and does not continue in the lumber. Its action upon wood is quite unique, in that the destructive action of the fungus is localized to definite areas in the wood. The area of infestation is confined to small pockets varying from one-half an inch to several inches long, and from one-quarter to three-quarters of an inch in diameter. Boards cut from pecky logs exhibit a unique appearance, in that the entire surface of the board is pitted with these pockets. The wood inside has either dried up entirely into a fine powder which soon disappears upon exposure to the air, or is a crumbling mass of dry, rotted wood.

The decayed pockets extend vertically up the tree. Strange to say, the walls of the pockets are sharply defined and the wood between the pockets is sound and undamaged. Hence, the damage of decay is confined to limited portions of the wood, and affects only the appearance of the wood and its strength qualities.

Brashness

Brashness in wood commonly means the tendency of the wood to fail suddenly under stress and break across the grain with little or no splintering. It is also called "brittleness."

If a piece of wood fails suddenly under bending, and the fracture takes place more or less abruptly across the grain in large jagged breaks instead of a fine splintering, undoubtedly the wood has brash qualities. (See Plate VIII.)

Brash wood does not exhibit brittleness nor deformation previous to its complete rupture.

Brashness is one of the mysteries of wood. Its causes are not definitely known, but there is apparently some relation between wood structure and brashness.

Undoubtedly, other factors enter into the cause for the failure of wood due to brashness. Three outstanding factors have been developed which indicate brashness in wood:

Exceptionally low specific gravity or weight of a piece, as compared to average weight for a given species
An especially small volume of summerwood
Fibers with thin walls

Brashness is a serious defect in wood when hardness or toughness of the piece is imperative. It is dangerous, inasmuch as failure is likely to take place suddenly and without notice, even under a light load.

The most practical method adopted in general by industry to safeguard against brashness in wood, is to examine and cull out stock the weight of which is noticeably light. No absolute criterion exists, however, which definitely identifies brashness.

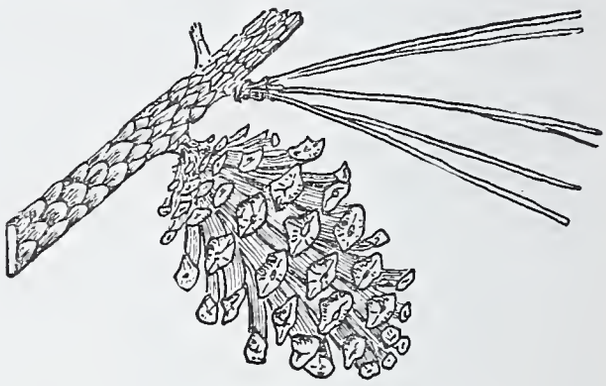
Hardwoods and Softwoods

The tree species of the United States have been divided into two distinct groups: namely, "hardwoods" and "softwoods." While the distinction was originated by botanists, lumbermen and others also use a nontechnical method of separation closely paralleling it.

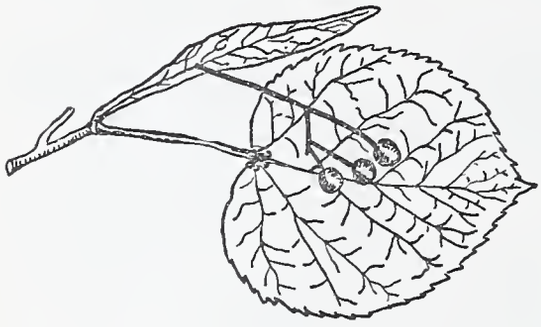
Many misconceptions are prevalent in regard to the separation and the use of the terms "hardwoods" and "softwoods."

The botanists separated the woods because of *variation in wood structure*, and not because of the relative hardness or softness of the woods (see page 23). Furthermore, the

A
EASTERN HEMLOCK



B
SHORT LEAF PINE



C
BASSWOOD

D
TRUE WHITE OAK

Illustration 2—A and B, Types of needle or scale-like leaves; C and D, Broad leaves.

botanical separation does not mean that hardwoods are harder than softwoods, nor that softwoods are softer than hardwoods, though such usually is true.

Again, botanists frequently use the terms "coniferous" and "deciduous." Types of leaves govern this separation. Deciduous trees (hardwoods) are those with broad leaves; coniferous trees have needle or scale-like leaves and bear cones. (See Illustration 2.)

Generally speaking, coniferous trees (evergreens) do not drop their leaves in the fall, while deciduous trees (broad-leaved) do; but exceptions are found in this classification.

For example, live oaks—which are true hardwoods (deciduous trees)—do not drop their leaves in the fall; cypress and larch—true softwoods (coniferous trees)—drop their leaves in the fall. These are only a few exceptions.

The botanical terms—which in reality are correct but are seldom used in the trade—separate hardwoods and softwoods as angiosperms (hardwoods, broad-leaved trees), meaning that the seeds are inclosed in an ovary; and gymnosperms (softwoods, evergreens, etc.), in which the seeds are not inclosed in an ovary.

The following list has been arranged to indicate important hardwood and softwood species, particularly those described in this book.

Hardwood Species

(Deciduous, broad-leaved trees, angiosperms)

- Alder
- Almon
- Ash
  - black
  - green
  - Oregon
  - red
  - white
- Basswood
- Beech
- Birch
  - paper
  - sweet
  - yellow
- Buckeye, yellow
- Butternut
- Cherry
- Chestnut
- Cottonwood
- Dogwood
- Elm
  - rock
  - slippery
  - white
- Gum
  - black
  - red
  - tupelo
- Hackberry
- Hickory
  - bigleaf
  - mockernut
  - pignut
  - shagbark
- Lauaan, red, etc.
- Maple
  - black
  - red
  - silver
  - sugar (hard)
- Magnolia
- Mahogany
  - true
  - "so-called"
- Oak
  - red
  - white
- Pecan
- Persimmon
- Poplar, yellow
- Sycamore
- Tanguile
- Walnut, black
- Willow

Softwood Species

(Coniferous, evergreen, needle-leaved trees, gymnosperms)

- Cedar
  - eastern red
  - incense
  - northern white
  - Port Orford
  - southern white
  - western red
  - yellow
- Cypress
- Fir, Douglas
- Fir, white
- Hemlock
  - eastern
  - West Coast
- Larch, western
- Pine
  - northern white
  - Norway
  - southern yellow
  - sugar
  - Idaho white
  - Pondosa (western yellow)
- Spruce
  - black
  - Englemann
  - red
  - Sitka
  - white
- Tamarack

PHYSICAL PROPERTIES OF WOOD

Color of Wood

Color in wood is sometimes greatly valued in certain uses, particularly where natural finish is required. It is not due to any microscopical differences in structure, but rather to infiltration of chemical products by which the cell walls are impregnated. Usually heartwood contains more of the infiltrated products, and hence in many species is darker than the sapwood. Color varies sometimes even in species, but it is nevertheless of value in the identification of species of wood.

In general, the color of wood darkens upon exposure to the air. Frequently highly-colored heartwoods lose their brilliant color and appear "aged." Heat darkens wood.

Dark-colored woods are generally more resistant to decay than light-colored woods.

Odor

In general all woods have odors, some of which are more pronounced than others. These are due to the presence of organic compounds such as oils, resins, and other volatile products in the cell walls and cavities. Because of volatility the odor is always more pronounced when the wood is freshly cut or is wet. Fungous action seems to change the natural odor of the wood.

Various species have definite odors which are characteristic, and, in the trade, those who are in contact continually with certain woods have learned to distinguish these odors as an aid in their identification.

Groups of woods have a particular odor: for example, the pines, in which a resinous odor is characteristic; the cedars, in which a "gingery" odor is prevalent; the oaks, in which a pungent, acid odor is predominant.

The fact that certain woods lose their odor almost entirely when dry is very important in the manufacture of containers.

Taste

Taste in wood has the same qualities and the same origin as odor. It is an important property of wood to be considered when food or candy is to be packed in any kind of wooden container.

Wood substance free from foreign products (oils, resins, gums, etc.) is both odorless and tasteless. These products are more or less soluble, and are much more evident when wood is wet. Volatility results in the lessening in strength of these odors if wood is exposed over a long period of time or becomes thoroughly dry.

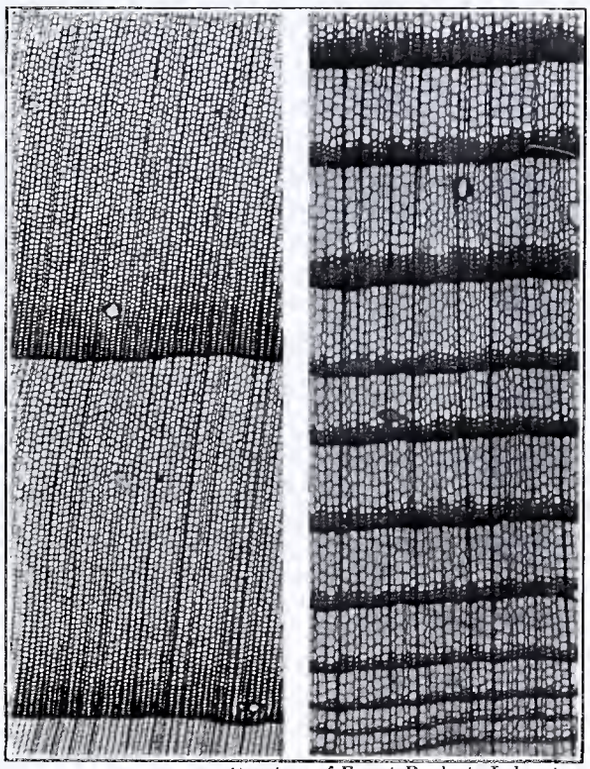
Luster

Luster refers to gloss in wood and is the result of the reflection of light by the cell walls. This ability of reflecting light largely depends upon smoothness of the surface, the manner in which it is cut, and the hardness of the wood. Cell walls reflect the light, while the cavities are naturally dull. Luster obviously, then, is more apparent in some species than in others.

In many species it is quite pronounced and typical of the wood. Spruce has a pronounced luster, while the redwoods are almost entirely lacking in this quality.

Sound

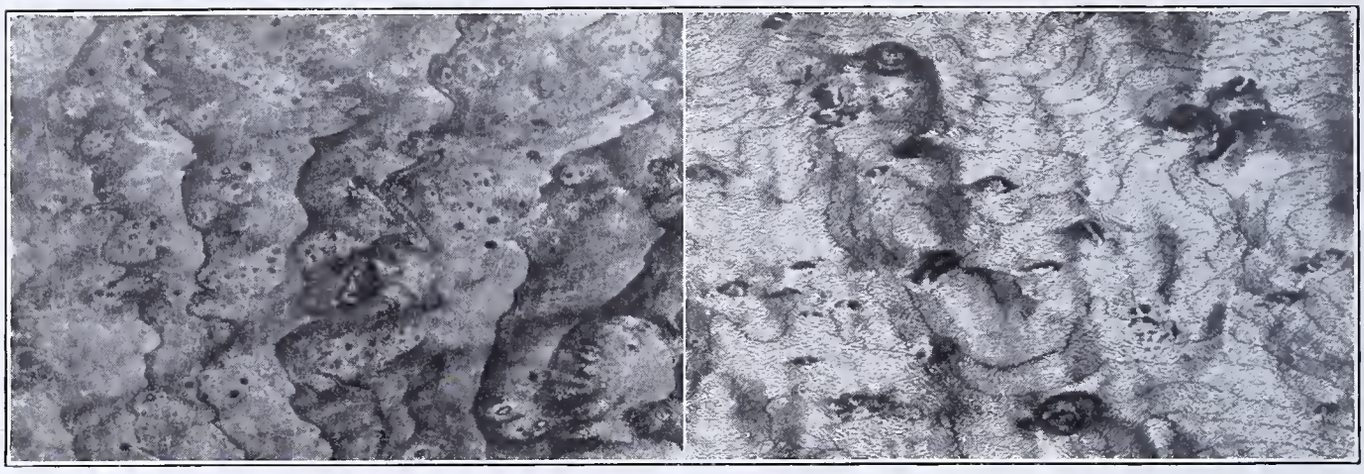
Wood offers low resistance to the transmission of sound. Species differ in their ability to transmit sound, according to the variations in the structure of the wood. The following



Courtesy of Forest Products Laboratory

A B

Plate V—A. Cross-section of white spruce, exhibiting fine, even texture, and gradual change from springwood to summerwood. B. Cross-section of western larch, with coarse, uneven texture; the change from springwood to summerwood is abrupt. The large, round openings are resin ducts in cross-section view. Wood sections magnified about 20 times.



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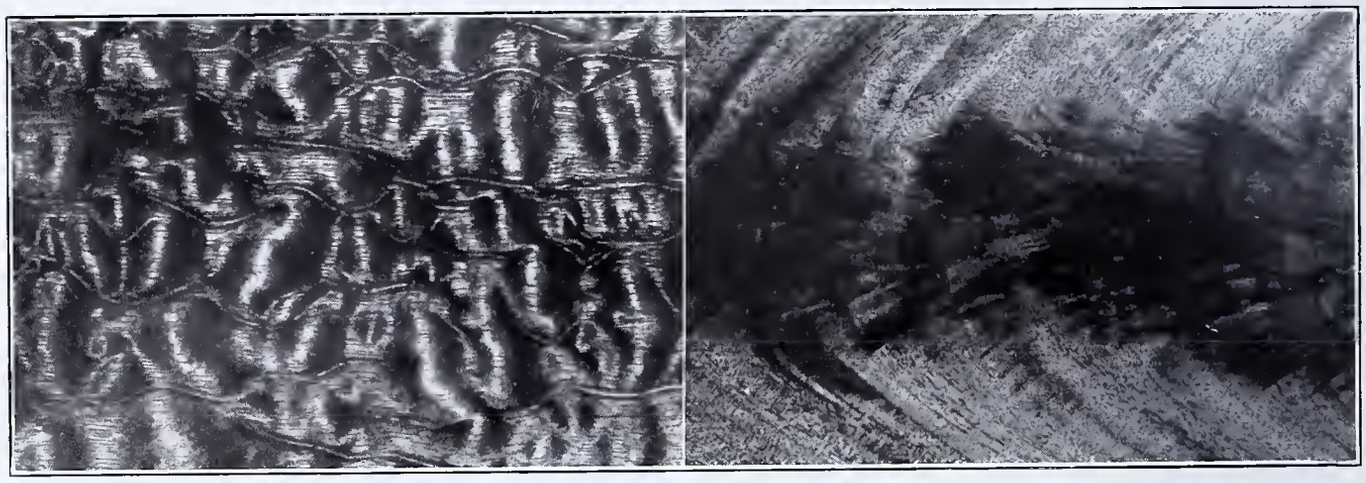

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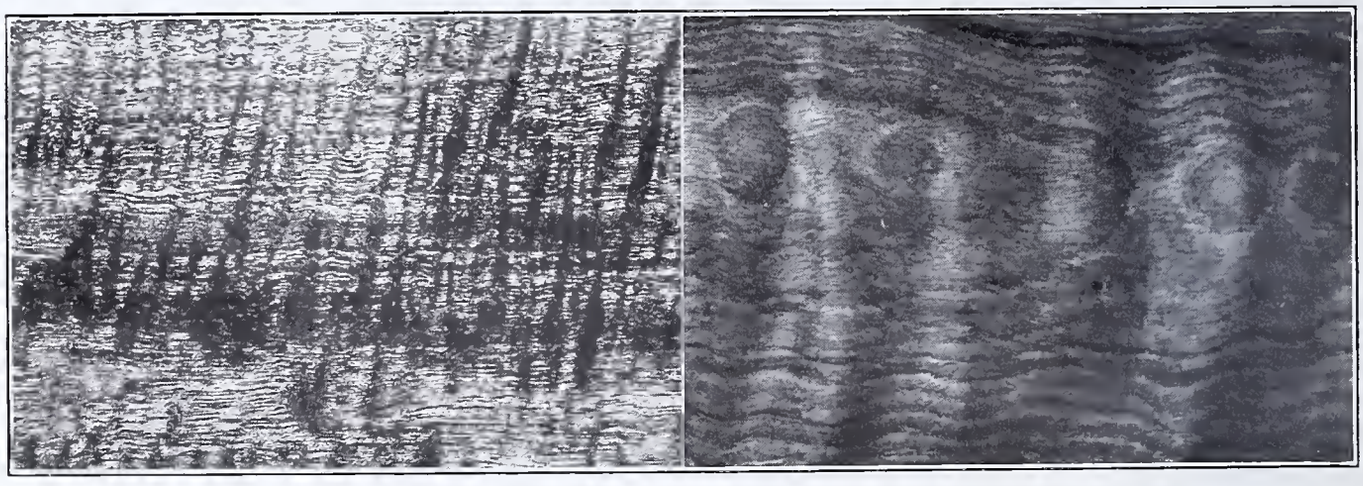


E F

Plate VI—Types of "figure" in various woods:

Courtesy of Forest Products Laboratory

A. Burl in cherry.
B. Bird's-eye in maple.
C. Blistered figure in mahogany.
D. Crotched mahogany.
E Fiddle-back figure in mahogany.

Courtesy of Northern Hemlock and Hardwood Mfgrs. Assn.

F Curly birch.

are those factors which should be observed in selecting wood with maximum sound-conducting properties:

Construction of cell walls
Freedom from defects
Absence of decay and moisture
Uniformity in texture
Straightness in grain
Uniformity in arrangement, size of cells, and weight of the wood, in addition to those factors listed above, are important qualities of wood to transmit sound

Wood does not vibrate tones as freely as metals, and for this reason it is preferred for purposes where sound deadening and absorbing of sound are required.

Spruce, maple, and yellow poplar are noted for their resonance and are much favored for sounding boards. Red gum is often used for valves in player pianos.

Decayed wood, which has lost much of its elasticity, does not produce as high a pitch or clear ring as undecayed wood.

Conductivity of Heat and Electricity

Electricity

Dry wood is practically a nonconductor of electricity. Green or wet wood, on the other hand, is a conductor and is influenced by its moisture content. Resinous woods offer greater resistance to electricity than nonresinous woods.

Heat

Wood is considered by many as an insulator against heat and cold; actually, it conducts a certain amount of heat, though slowly.

The rate at which heat passes through wood depends upon the density of the wood and the direction of the fibers. Dense wood conducts heat more rapidly than light wood, because in the light woods a larger volume is occupied by air spaces, and air is a poorer conductor of heat than the actual wood substance found in the cell walls.

It is because of this low conductivity that wood is a favorite for heat and cold insulating purposes, for flooring purposes, handles, etc.

Shrinkage and Swelling in Wood

Moisture occurs in wood in two ways. First as moisture or water which is imbibed or contained *within the cell walls*. Secondly as moisture or water which fills the *openings or cell cavities*.

As wood dries water leaves the cell cavities first, and later is followed by the loss of water in the cell walls. Immediately upon the loss of water in the cell walls they start to shrink in size and change their shape. This change is called shrinkage.

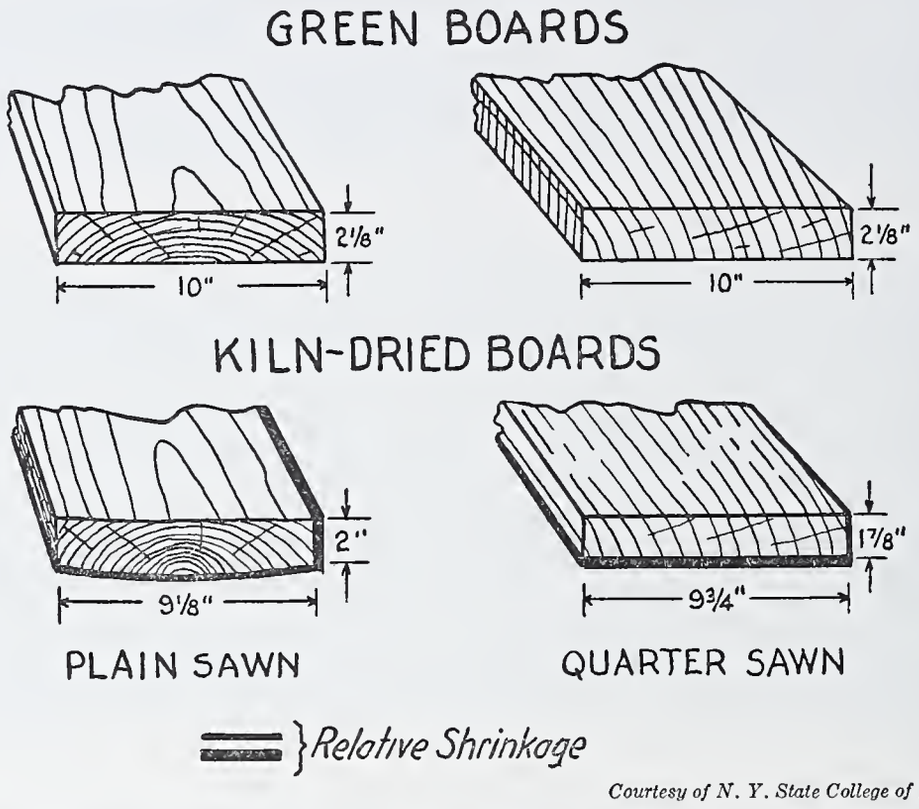
While water is leaving the cell cavities there is no apparent change in the size or shape of the piece of wood.

Swelling is the opposite of shrinkage.

The theory of shrinkage is quite involved, and is limited entirely to changes in the "elements" of wood. It is caused by contraction of the cell walls as the moisture leaves the wood. The amount of shrinkage in woods varies, nor does wood shrink evenly in all directions. For instance, there is practically no decrease in length in passing from maximum to

minimum water content. There is generally twice as much shrinkage in tangential cut (plain-sawed) boards as in radial cut (quarter-sawed) boards. (See Illustration 3.)

It is very important that shrinkage should take place prior to fabrication. For this reason, seasoning to a given moisture content produces a shrinkage value that makes the wood adaptable for a particular use and service.



Courtesy of N. Y. State College of Forestry

Illustration 3—Natural tendency of boards to warp and shrink. Note variations in the amount of shrinkage in plain-sawed and quarter-sawed boards.

Dense woods shrink more than light woods, not only in different types of wood within a tree, but also in different species. The shrinkage of the various species of wood is indicated in tables on mechanical properties. (See Table 2.)

Uneven shrinkage of wood is due to the following causes:

Differences in the rate of drying of different parts of the same piece of wood

Variations of density in the wood

Differences in rate of shrinkage in all directions

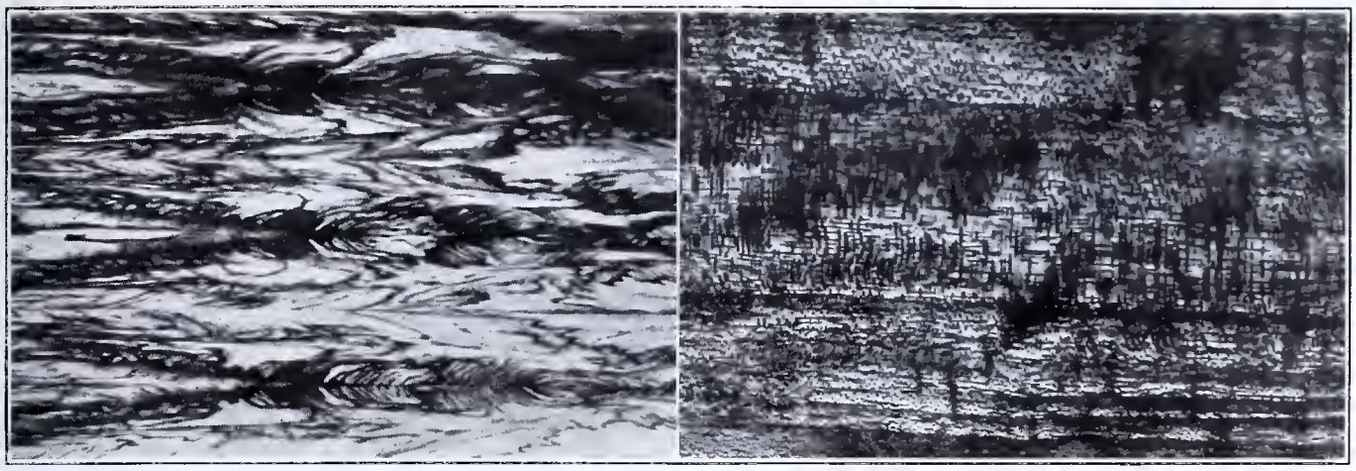
As a result of uneven shrinkage there are set up in the wood strains which eventually may cause checks, warping, twisting, etc.

Cupping is the tendency of a board to curl, the curl apparently resulting from an effort of the wood to straighten out the annual ring.

Checking

Checking is the opening of wood which results in hair-like slits in the surface. It is usually caused by extreme variations in the moisture content within the wood, which leads to a too rapid surface drying. It is commonly spoken of as end checking when the ends of logs or boards check, and surface checking when it occurs on the surface of boards.

Internal stresses set up within a piece of wood in drying react upon the fibers and



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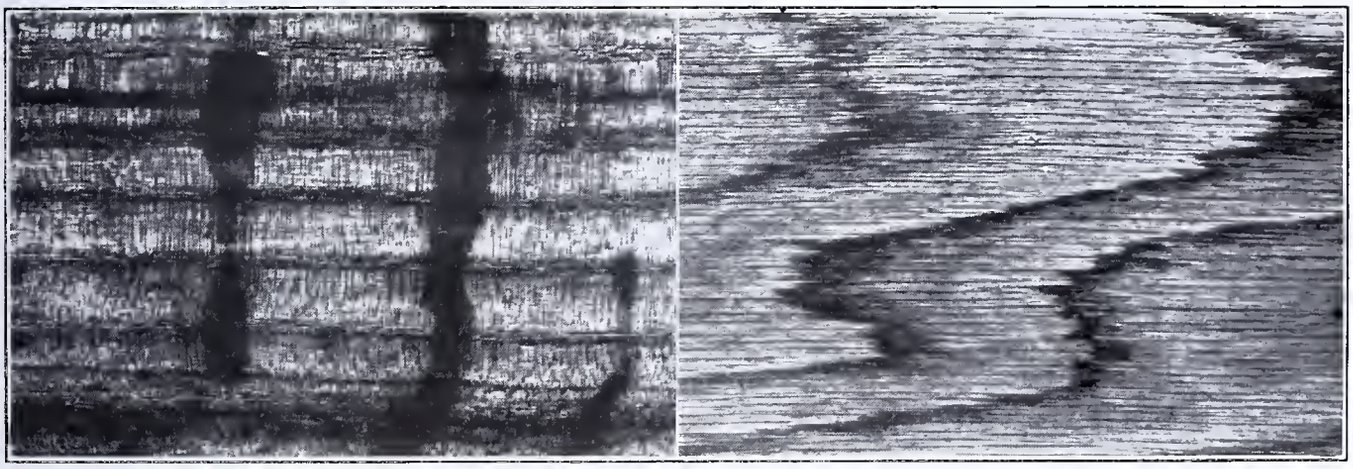

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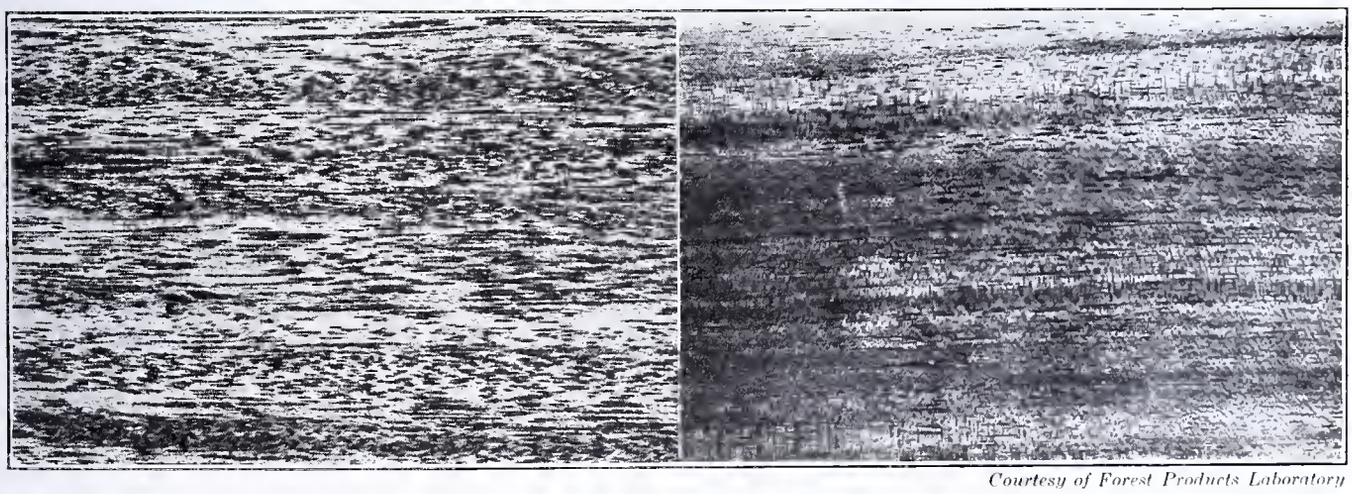
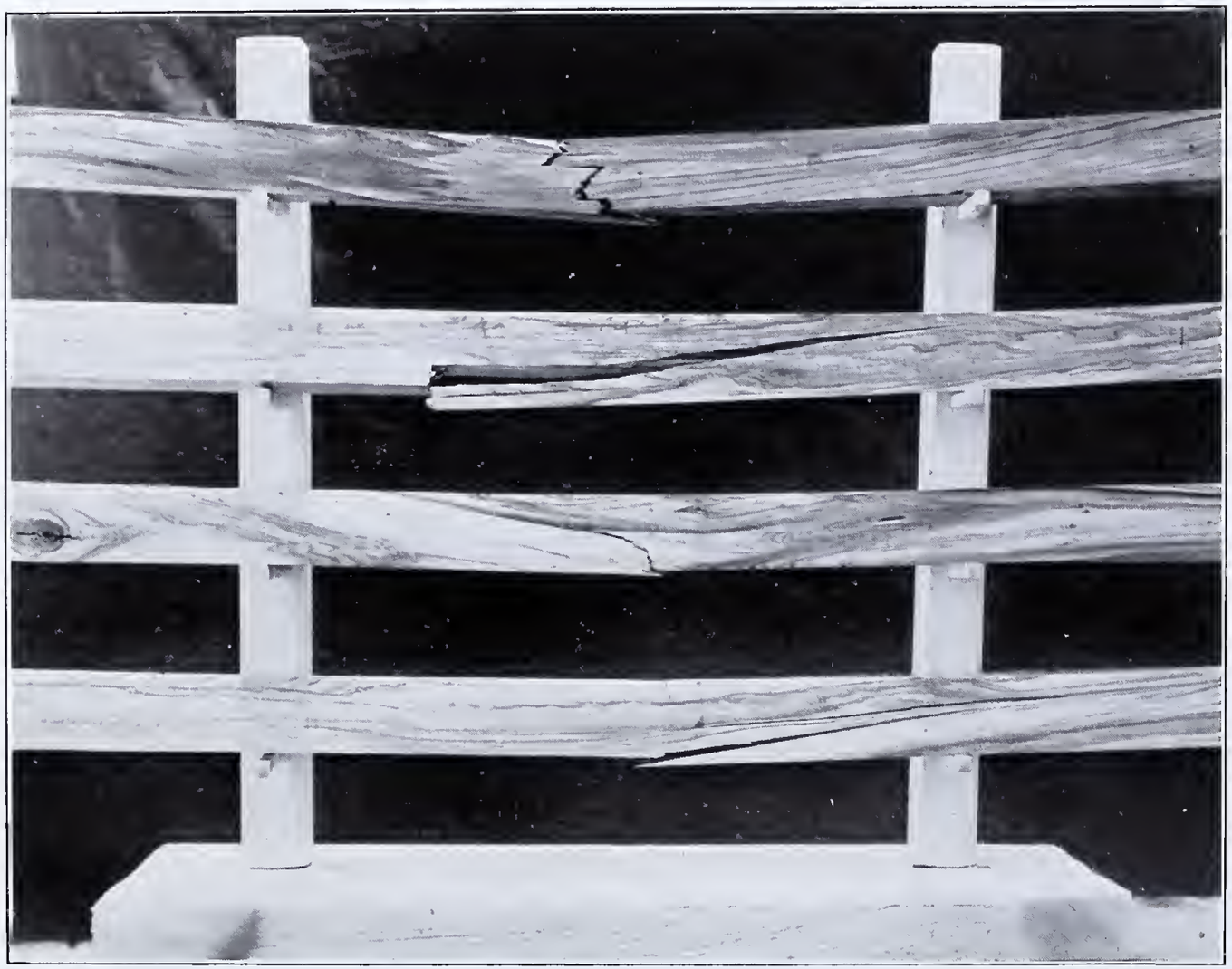


Courtesy of Forest Products Laboratory

E F

Plate VII—Types of "figure" in various woods:

A. Figured and matched red gum panel.
B. Mottled figure in quarter-sawed mahogany.
C. Quarter-sawed red oak.
D. Growth ring figure in rotary-cut red oak.
E. Ribbon stripe in tanguile.
F. Ribbon stripe in black walnut.



Courtesy of New York State College of Forestry

Plate VIII—Compression and tension failure in 2″ x 2″ x 28′ pieces of red gum. Pieces were supported at ends and load applied in the center, as indicated by points of failure. A. Test piece shows evidence of brashness. B. Test piece failed through tension and compression. C. Test piece failed through tension. D. Test piece failed through tension and compression.

cause them to rupture and tear apart or check. Checking usually occurs between and along the wood rays.

In plain-sawed boards checks occur on the surface of the piece, while in quartered boards they are found on the edge of the piece.

Warping

Warping is common in boards with spiral and interlocked grain. It is caused by unequal shrinkage in the piece due to irregularity in the fiber structure and arrangement, with respect to the edges and faces of the board.

Plain-sawed lumber with interlocked grain warps more than quartered stock. Proper piling assists greatly in minimizing warps and twists.

Weight of Wood

Weight of wood is of particular importance due to the increase or decrease of transportation and handling cost. It is also a most important factor in the selection of wood for various purposes. The weight of wood depends upon several factors:

The actual amount of wood substance present; i.e., its density
The quantity of mineral matter in the wood substance
The amount of nonmineral contents of the wood; pitch, gums, resins, etc.
The amount of moisture found in the wood

The weight of wood varies considerably; no two pieces have identical weight. Such variation is directly due to the amount of cell space present in the particular species of wood.

If a piece of wood has a large amount of air cavities the wood is generally light in weight. If thick-walled cells with small cavities are present, and gums and resins fill the pores of the wood, it is generally heavy.

One of the peculiarities of wood is that if dry wood could be completely compressed to a solid mass—air excluded, cells flattened, etc.—*it would weigh the same per cubic foot* for all species.

Cell-wall structure is the same in all woods, and weighs 1.54 times as much as an equal volume of water. A cubic foot of solid wood substance would weigh 96 pounds.

The buoyancy of wood depends upon the amount of cell cavities which control its ability to float. When timber becomes water-logged it means that water has completely filled these cavities.

Wood from different parts of the tree weighs differently. The lightest wood in a tree is found in the roots, while the heaviest is in the limbs.

The weight of wood is expressed in several ways. In the trade perhaps the most common is pounds per thousand board feet. It is also stated in pounds per cubic foot.

The terms "specific gravity" and "density" of wood are also used in discussions relative to the weight of wood. Specific gravity is the relation or ratio of the weight of wood to the weight of an equal volume of pure water. Wood with a specific gravity of .56 is $^{56}/_{100}$ times as heavy as an equal volume of water. The weight per cubic foot can be easily obtained by computations. (For example, a cubic foot of water weighs 62.5 pounds; wood with a specific gravity of .56 would weigh 35 pounds per cubic foot.)

The density of wood refers to the actual mass of a substance per unit volume, and is expressed in pounds per cubic foot, pounds per 1,000 board feet, etc. It is the *weight* of wood per unit measure.

Specific gravity is frequently used as a method of determining the relative strength of pieces of wood of the same species, particularly brash stock.

TABLE 1

THE MORE IMPORTANT SPECIES OF WOOD CLASSIFIED ACCORDING TO WEIGHT

(Compiled by the Forest Products Laboratory)

Species[1]	*Pounds per Cubic Foot at 12 to 15 Per Cent Moisture*[2]	*Specific Gravity Oven-dry based on Green Volume*	*Estimated Shipping Weight in Pounds per 1,000 Board Feet of Rough Lumber 1 Inch or More in Thickness*[3]
Very light Northern white cedar.	18 to 22	.25 to .30	2,100 to 2,300
Light Western red cedar, Engelmann spruce, red fir, basswood, yellow buckeye, incense cedar, balsam fir, Sitka spruce, black willow, white fir, noble fir, butternut.	22 to 27	.30 to .36	2,300 to 2,600
Moderately light Sugar pine, aspen, white spruce, white pine, grand fir, yellow poplar, cottonwood, red spruce, lodgepole pine, western yellow pine, eastern hemlock, western white pine, jack pine, chestnut, western hemlock, Douglas fir (mountain type), redwood, Port Orford cedar, bald cypress.	27 to 32	.36 to .42	2,600 to 3,000
Moderately heavy Sassafras, white elm, silver maple, cucumber, Norway pine, red gum, tupelo gum, Douglas fir (Pacific Coast type), sycamore, black ash, evergreen magnolia, black gum, pitch pine, black cherry, paper birch, western larch, red maple, slippery elm, hackberry, tamarack, shortleaf pine.	32 to 39	.42 to .50	3,000 to 3,500
Heavy Holly, loblolly pine, black walnut, white ash, beech, yellow birch, longleaf pine, sugar maple, commercial red oaks, rock elm, honey locust, slash pine, sweet birch, commercial white oaks.	39 to 49	.50 to .60	3,500 to 4,100
Very heavy Pecan hickories, hornbeam, dogwood, persimmon, true hickories, black locust.	49 to 61	.60 to .72	4,100 to 4,800

MECHANICAL PROPERTIES OF WOOD

Mechanical properties of wood may be defined as those which refer to its strength. In many cases the strength of wood is of paramount importance in regard to its use for specific purposes.

The strength value of one wood as compared to another must be studied, since economic conditions in industry force wood to compete with other materials. It has already been pointed out that no two pieces of wood are the same, and because of variations in

[1] Arranged in each group approximately in the order of increasing weight.

[2] The average weight of a cubic foot of kiln-dried wood at 8 per cent moisture is 1 to 2 pounds less than that of the same species air dried.

[3] Wood considered air-dry, but moisture content may vary considerably.

structure, moisture content, grades, etc., the absolute mechanical value of a species cannot be ascertained. In general, a given species will average within a certain range of its mechanical strength, but even then there are exceptions which fall either below or above average values of a given species of wood.

Numerous tests have been carried out in an effort to ascertain these average values. The Forest Products Laboratory, Madison, Wisconsin, has worked upon the strength properties of wood for many years, and recently has put into print the result of exhaustive study and research upon this problem. The results are based upon 130,000 tests conducted over a period of fifteen years, and have been published in *The Strength of North American Woods,* by H. S. Betts. See also *Comparative Strength Properties of Woods Grown in the United States,* by L. J. Markwardt.

It is admitted that the results obtained are not perfect, inasmuch as they do not represent average conditions as experienced in industry. After much research, however, it was determined that the mechanical properties of wood as expressed by bending tests, compression tests, shearing tests, tests of hardness, etc., to be strictly comparable must be made on straight-grained pieces of wood, free from defects, such as knots, shakes, etc., and of comparable moisture content. It is quite evident that it is entirely impractical and misleading to compare the strength of low grade and defective ash with clear basswood, or the strength of loblolly pine green from the saw to dry Douglas fir.

The results of the tests conducted by the Forest Products Laboratory are used as a basis for Table 2. In every instance it must be remembered that the results as shown should be accepted as an indication of those values, rather than absolute fixed values.

Explanation of Terms Used

It will be noted that for each of the species discussed, a series of strength values are shown in 23 columns. In order to present this information to possible consumers, it is necessary clearly to define the actual condition under which the particular test was made, and give an interpretation and explanation of the value derived.

Weights per Cubic Foot

Green (3); Air-dry (4); and Kiln-dry (5).

Column 3: Indicates average green values.

Column 4: Average 12 or 15 per cent moisture content; average condition reached, without artificial heating, by material sheltered from precipitation; North Central States.

Column 5: About 8 per cent.

Any individual lot of lumber in the condition specified in columns 3, 4, and 5 would probably vary 5 per cent from the figures given with a possible variation of as much as 20 per cent. For example, young thrifty pines will have a high moisture content when freshly cut and will probably weigh 20 per cent above the average given.

Specific Gravity

(Oven-dry based on volume when green.)

Column 6: The specific gravity of a wood is often used as a basis for its strength. Quite often in hickory and ash, where brashness is encountered, approximate strength values of stock can be determined by comparing the specific gravity of a known piece to those in question, and in many instances this would point out pieces wherein brashness might be expected.

TABLE 2

(Courtesy of the U. S. Forest Service)

The values in this table are based on small, clear, unseasoned green specimens 2 inches by 2 inches in cross-section. Bending span, 28 inches. Reference to column numbers will aid in reading the text which follows.

PROPERTIES OF VARIOUS WOODS, ACTUAL AND COMPARATIVE

Common and Botanical Name	Locality Where Grown	Weight per Cubic Foot			Specific gravity, oven-dry, based on volume when green	Shrinkage from Green to Oven-dry Condition			Strength in Bending		Strength in Compression Parallel to Grain		Strength in Compression Perpendicular to Grain		Stiffness		Hardness		Shock-resisting Ability		Shearing Strength Parallel to Grain	
		Green	Air-dry	Kiln-dry		In volume	Radial	Tangential	Modulus of rupture	Relative strength compared to oak (oak = 100)	Maximum crushing strength	Relative strength compared to oak (oak = 100)	Fiber stress at elastic limit	Relative strength compared to oak (oak = 100)	Modulus of elasticity in bending	Relative stiffness compared to oak (oak = 100)	Load required to imbed a 0.444-inch ball one-half its diameter	Relative hardness compared to oak (oak = 100)	Work to maximum load in bending	Relative shock-resisting ability compared to oak (oak = 100)	Shearing strength	Relative shearing strength compared to oak (oak = 100)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
HARDWOODS		Lbs.	Lbs.	Lbs.		Per cent	Per cent	Per cent	Lbs. per sq. in.		Lbs. per sq. in.		Lbs. per sq. in.		1,000 lbs. per sq. in.		Lbs.		Inch = lbs. per cu. in.		Lbs. per sq. in.	
Alder, red (Alnus rubra)	Snohomish County, Wash.	46	28	27	0.37	12.6	4.4	7.3	6,540	76	2,960	84	313	43	1,167	89	440	42	8.0	60	770	59
Ash, Biltmore white (Fraxinus biltmoreana)	Overton County, Tenn.	45	39	38	.51	12.6	4.2	6.0	9,270	107	3,930	113	875	120	1,335	102	853	81	11.6	87	1,232	94
Ash, black (Fraxinus nigra)	Ontonagon County, Mich.	53	36	34	.45	15.2	5.0	7.8	6,000	69	2,310	66	409	56	1,107	84	552	53	11.3	85	866	66
Do	Marathon County, Wis.	52	35	34	.47	....	....	....	6,000	69	2,260	64	452	62	960	73	....	....	13.1	98	....	....
Ash, blue (Fraxinus quadrangulata)	Bourbon County, Ky.	46	41	39	.53	11.7	3.9	6.5	9,650	112	4,180	118	994	137	1,241	95	1,028	98	14.7	111	1,543	118
Ash, green (Fraxinus pennsylvanica lanceolata)	Richland Parish, La.	47	39	38	.52	11.7	....	....	8,880	103	4,040	114	801	110	1,319	101	732	70	10.6	80	1,202	92
Do	New Madrid County, Mo.	49	42	40	.53	13.3	4.6	7.1	10,040	116	4,360	124	1,012	139	1,480	113	1,007	96	13.0	98	1,318	101
Ash, Oregon (Fraxinus oregona)	Lane County, Ore.	46	39	37	.50	13.2	4.1	8.1	7,570	88	3,510	99	653	90	1,132	86	790	75	12.2	92	1,191	91
Ash, pumpkin (Fraxinus profunda)	New Madrid County, Mo.	46	37	36	.48	12.0	3.7	6.3	7,600	83	3,360	75	939	136	1,043	80	752	72	9.4	71	1,214	93
Ash, white (Fraxinus americana)	Stone County, Ark.	47	42	41	.55	12.6	4.3	6.4	9,920	115	4,220	120	880	122	1,416	108	1,008	96	13.3	100	1,336	102
Do	Oswego County, N. Y.	51	46	44	.58	14.0	5.3	8.7	10,760	125	4,610	131	791	109	1,635	125	1,083	103	16.3	123	1,604	123
Do	Pocahontas County, W. Va.	46	38	37	.50	12.6	4.1	6.6	8,310	96	3,390	96	705	97	1,285	98	785	75	13.6	102	1,183	91
Basswood (Tilia glabra)	Potter County, Pa.	41	27	26	.33	16.5	6.8	9.0	5,270	61	2,450	69	221	30	1,149	88	263	25	4.9	37	626	48
Do	Marathon County, Wis.	41	25	24	.32	14.5	6.2	8.4	4,450	52	1,820	52	197	27	842	64	222	21	5.8	44	588	45
Beech (Fagus grandifolia)	Hendricks County, Ind.	56	45	43	.56	16.5	4.6	10.5	8,610	100	3,480	99	605	83	1,353	103	908	87	14.1	106	1,264	97
Do	Potter County, Pa.	54	43	41	.53	15.8	5.1	10.6	7,720	89	3,080	87	609	84	1,131	86	740	71	10.9	82	1,155	88
Birch, paper (Betula papyrifera)	Rusk County, Wis.	51	38	37	.47	16.3	6.6	8.8	5,770	67	2,210	63	304	42	1,013	77	486	46	15.0	113	786	60
Birch, sweet (Betula lenta)	Potter County, Pa.	59	47	45	.59	15.0	6.3	7.6	8,590	99	3,560	101	525	72	1,490	114	894	85	15.6	117	1,219	93
Birch, yellow (Betula lutea)	Do	56	45	43	.55	16.7	6.9	8.9	8,810	102	3,520	100	469	65	1,490	114	736	70	19.0	143	1,083	83
Do	Marathon County, Wis.	59	44	43	.54	17.0	7.0	9.0	8,390	97	3,490	96	439	60	1,597	122	754	72	14.2	107	1,145	88
Buckeye, yellow (Æsculus octandra)	Sevier County, Tenn.	49	25	24	.33	12.0	3.5	7.8	4,820	56	2,050	58	210	29	981	75	286	27	5.4	41	662	51
Butternut (Juglans cinerea)	Sauk County, Wis.	45	26	25	.35	9.1	3.6	5.7	5,870	68	2,580	73	258	35	1,008	77	394	38	8.4	63	761	58
Do	Sevier County, Tenn.	47	28	27	.36	11.1	3.0	6.5	4,880	56	2,250	64	287	39	931	71	379	36	7.9	59	748	57
Cherry, black (Prunus serotina)	Potter County, Pa.	46	36	34	.47	11.5	3.7	7.1	8,030	93	3,540	100	444	61	1,308	100	664	63	12.8	96	1,127	86
Cherry, pin (Prunus pennsylvanica)	Sevier County, Tenn.	33	28	27	.36	12.8	2.8	10.3	5,040	58	2,170	61	265	36	1,042	79	386	37	6.2	47	677	52
Chestnut (Castanea dentata)	Baltimore County, Md.	53	30	29	.40	10.1	3.3	6.6	6,010	70	2,710	77	400	55	949	72	448	43	7.4	56	845	65
Do	Sevier County, Tenn.	56	30	29	.39	12.0	3.4	6.8	5,220	61	2,230	63	366	50	910	69	402	38	6.7	50	740	57
Cottonwood (Populus deltoides)	Pemiscot County, Mo.	49	29	28	.37	14.1	3.9	9.2	5,260	61	2,280	65	242	33	1,013	77	344	33	7.3	55	681	52
Cottonwood, black (Populus trichocarpa)	Snohomish County, Wash.	46	24	23	.32	12.4	3.6	8.6	4,830	56	2,160	61	204	28	1,073	82	253	24	5.0	38	601	46

Dogwood (flowering) (Cornus florida)	Sevier Co., Tenn.	65	54	52	.64	19.9	7.1	11.3	8,790	102	3,640	103	1,033	142	1,175	90	1,408	134	21.0	158	1,516	116
Dogwood. Pacific (Cornus nuttallii)	Lane County, Ore.	55	47	45	.58	17.2	6.4	9.6	8,210	95	3,640	103	872	120	1,090	83	979	93	17.0	128	1,297	99
Elm, rock (Ulmus racemosa)	Marathon County, Wis.	53	44	43	.58	....	....	....	9,430	109	3,740	106	696	96	1,222	93	....	....	19.4	146	....	....
Do	Rusk County, Wis.	54	45	43	.57	14.1	4.8	8.1	9,550	111	3,820	108	813	112	1,165	89	988	94	20.3	153	1,276	98
Elm, slippery (Ulmus fulva)	Hendricks County, Ind.	53	43	42	.54	15.5	5.1	9.9	9,510	110	3,990	113	730	100	1,314	100	722	69	11.7	88	1,185	91
Do	Sauk County, Wis.	56	37	36	.47	13.4	4.9	8.7	7,710	89	3,180	90	468	64	1,215	93	653	62	16.1	121	1,089	83
Elm, American (Ulmus americana)	Potter County, Pa.	53	35	33	.44	14.4	4.2	9.5	7,010	81	2,920	83	410	56	1,020	78	546	52	11.2	84	922	71
Do	Marathon County, Wis.	45	33	32	.43	....	....	....	6,940	80	2,700	76	292	40	1,052	80	....	....	11.8	89	....	....
Gum, black (Nyssa sylvatica)	Sevier County, Tenn.	45	36	35	.46	13.9	4.4	7.7	7,040	81	3,040	86	599	82	1,031	70	642	61	8.0	60	1,097	84
Gum, tupelo (Nyssa aquatica)	Pemiscot County, Mo.	54	34	33	.45	12.5	4.2	7.5	7,290	84	3,330	94	620	85	1,054	80	710	68	8.4	63	1,227	94
Do	St. John's Parish, La.	66	37	35	.48	12.4	4.4	7.9	7,380	85	3,550	101	451	62	1,045	80	699	67	7.8	59	1,031	79
Gum, red (Liquidambar styraciflua)	New Madrid County, Mo.	46	35	....	.43	....	....	....	6,450	75	2,690	76	....	....	1,138	87	....	....	....	....	....	....
Do	Pemiscot County, Mo.	54	36	34	.45	15.0	5.2	9.9	7,230	84	2,990	85	455	63	1,154	88	522	50	9.4	71	1,072	82
Hackberry (Celtis occidentalis)	Hendricks County, Ind.	47	39	38	.50	14.0	4.2	8.9	7,800	90	3,310	94	575	79	1,170	89	784	75	19.6	147	1,128	86
Do	Sauk County, Wis.	51	38	36	.48	13.8	4.9	8.9	6,210	72	2,520	71	475	65	911	69	677	65	13.5	102	1,058	81
Hickory, nutmeg (Hicoria myristicæformis)	Sardis, Miss.	61	43	42	.56	....	....	....	9,060	105	3,980	113	938	129	1,289	98	....	....	22.8	171	1,031	79
Hickory, pignut (Hicoria glahra)	Do	62	50	48	.63	15.0	5.6	9.8	11,780	136	4,870	138	1,101	151	1,665	127	....	....	24.7	186	1,207	92
Do	Napoleon, Ohio	64	53	51	.66	15.3	6.3	9.5	12,360	143	4,760	135	1,224	168	1,553	118	....	....	27.7	208	1,427	109
Do	Chester County, Pa.	65	54	52	.66	16.9	6.8	10.9	11,450	133	4,820	137	1,130	155	1,605	122	....	....	34.9	262	1,358	104
Do	Webster County, W. Va.	63	57	55	.67	21.2	8.5	13.8	11,810	137	4,820	137	1,114	153	1,769	135	....	....	30.6	230	1,395	107
Hickory, shaghark (Hicoria ovata)	Sardis, Miss.	63	49	47	.61	16.0	6.5	10.2	11,330	131	5,060	143	1,158	159	1,638	125	....	....	16.7	126	1,262	97
Do	Napoleon, Ohio	64	54	51	.64	18.4	7.9	11.4	10,990	127	4,360	124	1,080	149	1,346	103	....	....	34.1	256	1,421	109
Do	Chester County, Pa.	63	47	45	.61	....	....	....	10,170	118	4,370	124	....	....	1,392	106	....	....	11.9	89	1,245	95
Do	Webster County, W. Va.	65	52	50	.65	15.5	6.5	9.7	11,000	127	4,600	130	972	134	1,752	134	....	....	18.3	138	1,263	97
Hickory, water (Hicoria aquatica)	Sardis, Miss.	69	46	44	.61	....	....	....	10,740	124	4,660	132	1,088	150	1,563	119	....	....	18.8	141	1,440	110
Pecan (Hicoria pecan)	Pemiscot County, Mo.	61	47	45	.60	13.6	4.9	8.9	9,770	113	3,990	113	959	132	1,367	104	1,308	125	14.6	110	1,481	113
Hickory, hig leaf shagbark (Hicoria laciniosa	Sardis, Miss.	62	49	47	.60	17.6	7.4	11.2	11,110	129	4,520	128	994	137	1,562	119	....	....	24.3	183	1,162	89
Do	Napoleon, Ohio	65	57	55	.65	20.9	7.9	14.2	9,880	114	3,260	92	1,000	138	1,099	84	....	....	36.2	272	1,212	93
Hickory, hitternut (Hicoria cordiformis)	Do	64	49	47	.60	....	....	....	10,280	119	4,570	129	986	136	1,399	107	....	....	20.0	150	1,237	95
Hickory, mockernut (Hicoria alha)	Sardis, Miss.	62	49	47	.61	16.5	6.9	10.4	10,840	125	4,600	130	1,065	146	1,625	124	....	....	18.6	140	1,270	97
Do	Chester County, Pa.	65	55	53	.66	18.9	8.4	11.4	11.110	129	4,320	122	958	132	1,508	115	....	....	31.7	238	1,282	98
Do	Webster County, W. Va.	62	....	....	.66	....	....	....	12,720	147	5,240	148	....	....	1,883	144	....	....	24.1	181	....	....
Magnolia, evergreen (Magnolia grandiflora)	Winn Parish, La.	62	35	34	.46	12.3	5.4	6.6	6,780	78	2,700	76	570	78	1,106	84	738	70	15.4	116	1,043	80
Cucumber tree (Magnolia acuminata)	Sevier County, Tenn.	50	34	33	.44	13.6	5.2	8.8	7,420	86	3,140	89	408	56	1,565	119	515	49	10.0	75	991	76
Maple, higleaf (Acer macrophyllum)	Snohomish County, Wash.	47	34	32	.44	11.6	3.7	7.1	7.390	86	3,240	92	554	76	1,095	84	624	60	8.7	65	1,108	85
Maple, red (Acer ruhrum)	Marathon County, Wis.	54	38	37	.51	....	....	....	8,310	96	3,680	104	606	83	1,445	110	....	....	9.8	74	....	....
Do	Potter County, Pa.	49	36	34	.46	12.5	3.8	8.1	7,470	86	3,090	88	456	63	1,395	106	603	58	11.3	85	1,084	83
Maple, silver (Acer saccharinum)	Sauk County, Wis.	46	34	32	.44	12.0	3.0	7.2	5,820	67	2,490	71	456	63	943	72	592	56	11.0	83	1,053	81
Maple, sugar (Acer saccharum)	Hendricks County, Ind.	54	43	41	.55	14.3	4.9	9.1	8,860	103	3,670	104	653	90	1,462	112	910	87	12.7	95	1,324	101
Do	Potter County, Pa.	58	44	42	.55	14.7	4.8	9.2	9,490	110	3,870	110	704	97	1,524	116	920	88	13.6	102	1,380	106
Do	Marathon County, Wis.	56	44	42	.58	....	....	....	8,820	102	4,000	113	870	120	1,437	110	....	....	9.6	72	....	....
Oak, post (Quercus stellata)	Stone County, Ark.	60	47	46	.59	16.0	5.7	10.6	7,380	85	3,330	94	1,148	158	913	70	1,074	102	9.1	68	1,299	99
Do	Winn Parish, La.	66	49	47	.60	16.5	5.2	8.9	8,780	102	3,620	103	964	133	1,259	96	1,182	113	13.0	98	1.256	96
Oak, red (Quercus borealis maxima	Stone County, Ark.	65	45	43	.57	14.5	4.2	8.3	8,100	94	3,440	97	844	116	1,248	95	1,042	99	12.7	95	1,220	93
Do	Hendricks County, Ind.	64	44	42	.57	13.1	3.7	8.3	7,780	90	3,210	91	807	111	1,268	97	1,011	96	11.4	86	1,163	89
Do	Richland Parish, La.	67	50	48	.56	....	....	....	8,120	94	3,460	98	682	94	1,474	112	892	85	9.8	74	1,053	81
Do	Sevier County, Tenn.	61	42	41	.53	15.3	3.7	8.3	6,790	79	2,700	76	554	76	1,170	89	854	81	12.1	91	1,020	78
Oak, swamp, red (Quercus ruhra pagdæfolia)	Winn Parish, La.	67	49	47	.61	16.4	5.2	10.8	10,850	126	4,620	131	944	130	1,790	137	1,244	119	14.7	111	1,321	101
Oak, southern red (Quercus ruhra)	Do	62	42	40	.52	16.3	4.5	8.7	6,920	80	3,030	86	675	93	1,141	87	862	82	8.0	60	934	72
Oak, swamp white (Quercus hicolor)	Hendricks County, Ind.	69	52	50	.64	17.7	5.5	10.6	9,860	114	4,360	124	943	130	1,593	122	1,158	110	14.5	109	1,296	99
Oak, water (Quercus nigra)	Winn Parish, La.	63	45	43	.56	16.4	4.2	9.3	8,910	103	3,740	106	766	105	1,552	118	1,006	96	11.1	83	1.240	95
Oak, white (Quercus alba)	Stone County, Ark.	59	48	46	.59	15.8	6.2	8.3	8,090	94	3,520	100	829	114	1,137	87	986	94	12.1	91	1,194	91
Do	Hendricks County, Ind.	61	47	46	.60	14.3	4.9	9.0	8,640	100	3,530	100	727	100	1,311	100	1,048	100	13.3	100	1,306	100
Do	Richland Parish, La.	67	48	46	.60	16.0	4.8	9.2	7,760	90	3,490	99	1,004	138	1,194	91	1,155	110	8.9	67	1,253	96
Do	Winn Parish, La.	63	47	46	.59	16.9	5.4	9.5	8,690	101	3,700	105	757	104	1,344	103	1,039	99	11.9	89	1,243	95
Oak willow (Quercus phellos)	Do	67	46	45	.56	18.9	5.0	9.6	7,400	86	3,000	85	754	104	1,286	98	978	93	8.8	66	1,184	91
Oak. yellow (Quercus velutina)	Stone County, Ark.	63	45	43	.57	14.2	4.5	9.7	8,570	99	3,700	105	912	125	1,219	93	1,057	101	11.7	88	1,179	90
Do	Marathon County, Wis.	62	42	40	.55	....	....	....	7,650	89	3,080	87	802	110	1,121	86	....	....	13.2	99	....	....
Oak, hur (Quercus macrocarpa)	Sauk County, Wis.	61	45	43	.58	12.7	4.4	8.8	7,180	83	3,290	93	836	115	877	67	1,108	106	10.7	80	1,353	104
Oak, chestnut (Quercus montana)	Sevier County, Tenn.	62	46	45	.57	16.7	5.5	9.7	8,030	93	3.520	100	657	90	1,372	105	894	85	9.4	71	1,211	93
Oak, swamp chestnut (Quercus prinus)	Winn Parish, La.	65	50	48	.60	19.4	5.9	9.2	8,480	98	3.540	100	707	97	1,350	103	1,106	106	12.8	96	1,262	97
Oak, laurel (Quercus laurifolia)	Do	65	47	45	.56	19.0	3.9	9.5	7,940	92	3,170	90	707	97	1,393	106	996	95	11.2	84	1,182	91
Persimmon (Diospyrus virginiana)	.....	63	53	51	.64	18.3	7.5	10.8	10,030	116	4,170	118	1,110	153	1,367	104	1,279	122	13.0	98	1,474	113
Yellow poplar (Liriodendron tulipifera)	Do	38	28	27	.37	11.4	4.1	6.9	5,570	64	2,550	72	310	43	1,207	92	338	32	5.6	42	787	60
Sycamore (Platanus occidentalis)	Hendricks County, Ind.	51	35	34	.45	13.5	5.0	7.3	6,300	73	2,790	79	433	60	964	74	580	55	7.1	53	1,001	77
Do	Sevier County, Tenn.	53	36	35	.46	14.8	5.2	7.9	6,640	77	3,060	87	468	64	1,166	89	638	61	7.9	59	990	76
Walnut, hlack (Juglans nigra)	Kentucky	58	39	37	.51	11.3	5.2	7.1	9,490	110	4,300	122	601	83	1,420	108	899	86	14.6	110	1,216	93

TABLE 2 (*Continued*)

Common and Botanical Name	Locality Where Grown	Weight per Cubic Foot			Specific gravity, oven-dry, based on volume when green	Shrinkage from Green to Oven-dry Condition			Strength in Bending		Strength in Compression Parallel to Grain		Strength in Compression Perpendicular to Grain		Stiffness		Hardness		Shock-resisting Ability		Shearing Strength Parallel to Grain	
		Green	*Air-dry*	*Kiln-dry*		*In volume*	*Radial*	*Tangential*	*Modulus of rupture*	*Relative strength compared to oak (oak = 100)*	*Maximum crushing strength*	*Relative strength compared to oak (oak = 100)*	*Fiber stress at elastic limit*	*Relative strength compared to oak (oak = 100)*	*Modulus of elasticity in bending*	*Relative stiffness compared to oak (oak = 100)*	*Load required to imbed a 0.44-inch ball one-half its diameter*	*Relative hardness compared to oak (oak = 100)*	*Work to maximum load in bending*	*Relative shock-resisting ability compared to oak (oak = 100)*	*Shearing strength*	*Relative shearing strength compared to oak (oak = 100)*
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
SOFTWOODS		*Lbs.*	*Lbs.*	*Lbs.*		*Per cent*	*Per cent*	*Per cent*	*Lbs. per sq. in.*		*Lbs. per sq. in.*		*Lbs. per sq. in.*		*1,000 lbs. per sq. in.*		*Lbs.*		*Inch = lbs. per cu. in.*		*Lbs. per sq. in.*	
Cedar, incense (Libocedrus decurrens)	Lane County, Ore.	49	24	23	0.33	7.6	3.3	5.7	6,400	74	3,270	93	393	54	926	71	389	37	6.4	48	834	64
Do	Weed, Calif.	41	....	....	.36	....	....	....	6,040	70	3,030	86	518	71	754	58	....	....	....	....	....	....
Cedar, Port Orford (Chamæcyparis lawsoniana)	Douglas County, Ore.	39	31	30	.41	10.7	5.2	8.1	6,800	79	3,280	93	385	53	1,497	114	475	45	7.8	59	881	67
Cedar, western red (Thuja plicata)	Missoula County, Mont.	24	22	21	.29	7.6	2.5	4.6	4,750	55	2,630	75	278	38	886	68	246	23	4.5	34	697	53
Do	Snohomish County, Wash.	30	24	23	.33	8.6	2.5	5.6	5,730	66	3,050	86	351	48	1,021	78	272	26	5.6	42	742	57
Cedar, northern white (Thuja occidentalis)	Shawano County, Wis.	28	21	21	.29	7.0	2.1	4.9	4,250	49	1,990	56	288	40	643	49	226	22	5.7	41	615	47
Cypress, Alaska (Chamæcyparis nootkatensis)	Lane County, Ore.	35	29	28	.40	7.9	1.9	5.0	6,180	72	2,880	82	409	56	965	74	408	39	9.5	71	820	63
Cypress, southern (Taxodium distichum)	St. John the Baptist Parish, La.	51	34	33	.45	11.5	3.8	6.0	7,110	82	3.960	112	548	75	1,378	105	354	34	5.1	38	822	63
Do	Pemiscot, Mo.	47	29	28	.39	10.1	....	....	6,600	76	3,170	90	424	58	1.061	81	403	38	7.3	55	822	63
Fir, silver (Abies amabilis)	Dee, Ore.	52	....	....	.38	....	....	....	6,570	76	3,040	86	334	46	1,323	101	....	....	....	....	....	....
Do	Snohomish County, Wash.	36	27	26	.35	14.1	4.5	10.0	5,660	66	2,670	76	289	40	1,257	96	310	30	6.0	45	673	52
Fir, Alpine (Abies lasiocarpa)	Grand County, Colo.	28	23	22	.31	9.0	2.5	7.1	4,450	52	2,060	58	307	42	861	66	219	21	4.4	33	613	47
Fir, balsam (Abies balsamea)	Rusk County, Wis.	45	25	24	.34	10.8	2.8	6.6	4,900	57	2,400	68	210	29	964	74	291	28	4.7	35	612	47
Fir, Douglas (Pseudotsuga taxifolia)	Plumas County, Calif.	40	31	30	.40	11.7	4.5	6.9	6,980	81	3,420	97	447	61	1,376	105	423	40	6.2	47	781	60
Do	Humboldt County, Calif.	40	33	32	.44	10.7	4.9	7.7	7,500	87	3,830	109	540	74	1,508	115	524	50	6.8	51	961	74
Do	Johnson County, Wyo.	34	32	31	.42	10.9	3.7	6.6	6,340	73	2,920	83	427	59	1,242	95	408	39	7.0	53	855	65
Do	Lane County, Ore.	39	36	35	.46	13.2	5.7	7.6	7,860	91	4,080	116	541	74	1,679	128	514	49	7.0	53	881	67
Do	Chehalis County, Wash.	36	32	31	.41	12.5	4.4	7.4	7,010	81	3,410	97	485	67	1,407	107	427	41	6.1	46	940	72
Do	Lewis County, Wash.	41	37	35	.47	12.3	5.0	8.3	8,030	93	4,130	117	558	77	1,623	124	480	46	6.8	51	906	69
Do	Washington and Oregon	37	....	....	.46	....	....	....	8,280	96	4,030	114	....	....	1,597	122	....	....	....	....	....	....
Do	Missoula County, Mont.	35	29	28	.39	10.3	3.5	5.7	6,380	74	3,090	88	472	65	1,122	86	393	38	6.5	49	897	69
Fir, lowland (Abies grandis)	Do	37	29	28	.38	10.9	3.5	6.8	6,090	70	3,030	86	316	43	1,311	100	375	36	6.2	47	735	56
Do	Douglas County, Ore.	52	27	26	.36	10.2	2.9	7.5	6,030	70	2,990	85	355	49	1,286	98	348	33	5.0	38	786	60
Fir noble (Abies nobilis)	Multnomah County, Ore.	31	28	27	.35	13.6	4.9	9.1	5,690	66	2,700	76	309	43	1,281	98	254	24	6.2	47	698	53
Fir, white (Abies concolor)	Madera County, Calif.	56	26	25	.35	10.2	3.4	7.0	5,970	69	2,800	79	445	61	1,131	86	328	31	5.2	39	732	56
Hemlock, eastern (Tsuga canadensis)	Sevier County, Tenn.	48	32	31	.43	11.6	3.8	7.8	7,600	88	3,790	107	574	79	1,330	101	468	45	6.9	52	951	73
Do	Maratbon County, Wis.	49	25	24	.34	9.2	2.3	5.0	5,770	67	2,750	78	420	58	917	70	344	33	6.6	50	801	61
Hemlock, mountain (Tsuga mertensiana)	Missoula County, Mont.	45	32	30	.42	10.8	4.4	7.1	6,030	70	2,890	82	399	55	936	71	464	44	9.4	71	884	68

Hemlock, West Coast (Tsuga heterophylla)	Chehalis County, Wash	41	29	28	.38	11.6	4.5	7.9	6,070	70	2,890	82	350	48	1,192	91	432	41	6.0	45	808	62
Do	Gray's Harbor and Buckley, Wash	40	31	30	.42	....	....	....	7,290	84	3,390	96	....	....	1,428	109	....	....	....	....	....	....
Larch, western (Larix occidentalis)	Missoula County, Mont	51	39	37	.50	13.2	4.2	8.1	7,630	88	3,870	110	559	77	1,369	104	452	43	7.1	53	917	70
Do	Stevens County, Wash	42	34	33	.46	....	....	....	7,250	84	3,700	105	....	....	1,310	100	....	....	....	....	....	....
Pine, northern white (Pinus strobus)	Shawano County, Wis	39	27	26	.36	7.8	2.2	5.9	5,310	61	2,720	77	314	43	1,073	82	296	28	5.9	44	644	49
Pine. Norway (Pinus resinosa)	Shawano County, Wis	42	34	32	.44	11.5	4.6	7.2	6,430	74	3,080	87	358	49	1,384	106	342	33	5.8	44	776	59
Pine, longleaf (Pinus palustris)	Nassau County, Fla	51	44	42	.57	12.2	5.1	6.9	8,580	99	4,340	123	576	79	1,615	123	602	57	7.6	57	1,066	82
Do	Bogalusa, La	56	42	41	.55	12.4	5.5	7.8	9,400	109	4,620	131	707	97	1,752	134	664	63	8.9	67	1,150	88
Do	Lake Charles. La	45	43	42	.56	12.8	5.4	7.8	8,930	103	4,550	129	628	86	1,653	126	595	57	8.1	61	1,062	81
Do	Tangipahoa Parish, La	54	41	39	.53	12.8	6.0	7.6	8,630	100	4.280	121	491	68	1,662	127	512	49	8.1	61	1,006	77
Do	Hattiesburg, Miss	42	40	38	.52	11.0	4.8	7.5	7,730	89	4,020	114	513	71	1,406	107	526	50	7.0	53	1,034	79
Pine, pitch (Pinus rigida)	Sevier County, Tenn	54	36	35	.47	11.7	4.8	7.4	6,680	77	3,040	86	510	70	1,118	85	484	46	8.5	64	949	73
Pine, pond (Pinus rigida serotina)	Nassau County, Fla	49	40	38	.50	11.2	5.1	7.1	7,450	86	3,660	104	544	75	1,281	98	510	49	7.5	56	936	72
Pine, shortleaf (Pinus echinata)	Malvern, Ark	45	36	35	.48	....	....	....	7,710	89	3,570	101	400	55	1,395	106	....	....	....	....	708	54
Do	Bogalusa, La	56	39	37	.51	12.6	5.1	8.2	8,210	95	4,050	115	550	76	1,506	115	558	53	8.7	65	1,071	82
Pine, loblolly (Pinus tæda)	Nassau County, Fla	54	39	37	.50	12.6	5.5	7.5	7,620	88	3,670	104	548	75	1,431	109	452	43	8.0	60	903	69
Do	North Carolina and South Carolina	53	....	....	.51	....	....	....	7,300	84	3,402	96	....	....	1,293	99	....	....	....	....	....	....
Pine, slash (Pinus carihuea)	Nassau County, Fla	53	45	43	.58	12.7	5.9	7.5	8,800	102	4,470	127	592	81	1,631	124	628	60	7.9	59	1,033	79
Pine, sugar (Pinus lambertiana)	Madera County, Calif	50	27	26	.36	8.4	2.9	5.6	5,270	61	2,600	74	353	49	966	74	324	31	5.0	38	708	54
Pine, Idaho white, Western white (Pinus monticola)	Missoula County, Mont	39	30	29	.39	11.5	4.1	7.4	5,700	66	3,070	87	303	42	1,329	101	333	32	5.1	38	711	54
Pine, Pondosa, California white, western yellow (Pinus ponderosa)	Coconino County, Ariz	44	26	25	.35	9.2	4.1	6.4	4,760	55	2,220	63	342	47	879	67	314	30	4.9	37	662	51
Do	Madera County, Calif	53	29	28	.38	11.5	4.3	7.3	5,180	60	2,420	59	326	45	1,111	85	314	30	4.3	32	696	53
Do	Douglas County, Colo	47	29	28	.39	9.9	3.8	5.8	5,460	63	2,600	74	410	56	1,053	80	331	32	6.0	45	705	54
Do	Missoula County, Mont	51	28	27	.37	9.3	3.5	5.9	4,950	57	2,370	67	313	43	865	66	322	31	5.2	39	674	52
Do	Stevens County, Wash	36	....	....	.42	....	....	....	5,670	66	2,700	76	299	41	1,160	88	....	.....	....	....	....	....
Redwood (Sequoia sempervirens)	Humboldt County, Calif	38	24	23	.33	....	....	....	6,560	76	3,820	108	539	74	1,024	78	....	.....	....	....	....	....
Do	Mendocino County, Calif	39	27	26	.37	....	....	....	7.460	86	4,160	118	618	85	1,101	84	....	.....	....	....	....	....
Spruce, Engelmann (Picea engelmanni)	San Miguel County, Colo	48	23	22	.30	10.3	3.0	6.2	3.850	45	1,800	51	279	38	798	61	221	21	5.0	38	569	44
Do	Grand County, Colo	29	25	24	.32	10.5	3.7	6.9	4,550	53	2,170	61	302	42	866	66	264	25	4.8	36	615	47
Spruce, red (Picea rubra)	Coos County, N. H	32	29	28	.40	....	....	....	5,820	67	2,920	83	322	44	1,143	87	349	33	6.0	45	768	59
Do	Sevier County, Tenn	35	28	27	.37	11.8	3.8	7.8	5,600	65	2,600	74	368	51	1.215	93	346	33	6.2	47	764	58
Spruce, sitka (Picea sitchensis)	Chehalis County, Wash	33	26	25	.34	11.2	4.5	7.4	5,490	64	2,600	74	326	45	1,185	90	369	35	6.4	48	777	59
Spruce, white (Picea glauca)	Coos County, N. H	28	26	25	.32	....	....	....	5,200	60	1,940	55	262	36	968	74	274	26	6.6	50	630	48
Do	Rusk County, Wis	35	30	29	.38	14.8	3.7	7.3	5.410	63	2,550	72	267	37	988	75	278	27	5.4	41	691	53
Tamarack (Larix laricina)	Shawano County, Wis	47	38	37	.49	13.6	3.7	7.4	7,170	83	3,480	99	480	66	1,236	94	375	36	7.2	54	863	66

Specific gravity is determined on the basis of green wood. In the case of partially dry wood there would be some shrinkage with a consequent increase in specific gravity or density. This increase for air-dry wood (12 to 15 per cent moisture) gives a specific gravity about 10 per cent higher than for green wood. For kiln-dry wood the specific gravity would be still higher.

Shrinkage from Green to Oven-dry Condition

Column 7: In *total* volume.

Column 8: Radial shrinkage.

Column 9: Tangential shrinkage.

The necessity for the proper shrinkage of wood prior to its use is apparent, as already discussed. The shrinkage of various species of wood varies and for this reason often the question of comparable shrinkage between species is most important. These values express shrinkage which could be expected in the whole board, in a plain-sawed board, or in a quarter-sawed board.

Oven-dry means entirely free from water. The shrinkage from a green to a kiln-dry condition (8 per cent moisture) is generally about 75 per cent of the shrinkage to an oven-dry condition. The shrinkage from a green to an air-dry condition (12 to 15 per cent moisture) is generally about 50 per cent of the shrinkage to an oven-dry condition.

Strength in Bending: Modulus of Rupture

The modulus of rupture for practical purposes refers to the cross-breaking strength of a wood beam under a slowly applied load for a short time, and values given indicate the number of pounds per square inch applied before the piece broke, when supported as shown. Modulus of rupture may be expressed, also, as a measure of the breaking strength or the ultimate strength of wood. It has many practical applications.

Safe working stresses for a select grade of structural timbers, such as floor joists, stringers, etc., with all exceptionally light pieces excluded, subjected to bending in dry interior construction, are about one-sixth the modulus of rupture values given in the table. The values given are for green wood. The modulus of rupture for air-dry wood is about 50 per cent greater than that for green. For kiln-dry wood it is about 100 per cent greater, or twice the green value. This increase in strength due to drying does not apply to comparatively large structural timbers, in which the defects induced in the drying process, such as checks and shakes, frequently offset any increase in the strength of the wood itself.

Strength in Compression Parallel *to Grain*

Columns 12, 13: Maximum crushing strength.

Figures shown indicate the crushing strength for green wood in pounds per square inch, and the relative strength compared to oak. For air-dry wood the crushing strength is about 50 per cent greater than that of green stock, and for kiln-dry stock, about 100 per cent greater, or twice that for green. These values indicate the ability to support a slowly applied load for a short time before failure takes place. (See Plate IX.) Its commercial application is required in figuring the strength of short columns. A safe working stress is about one-fourth the crushing strength, as shown.

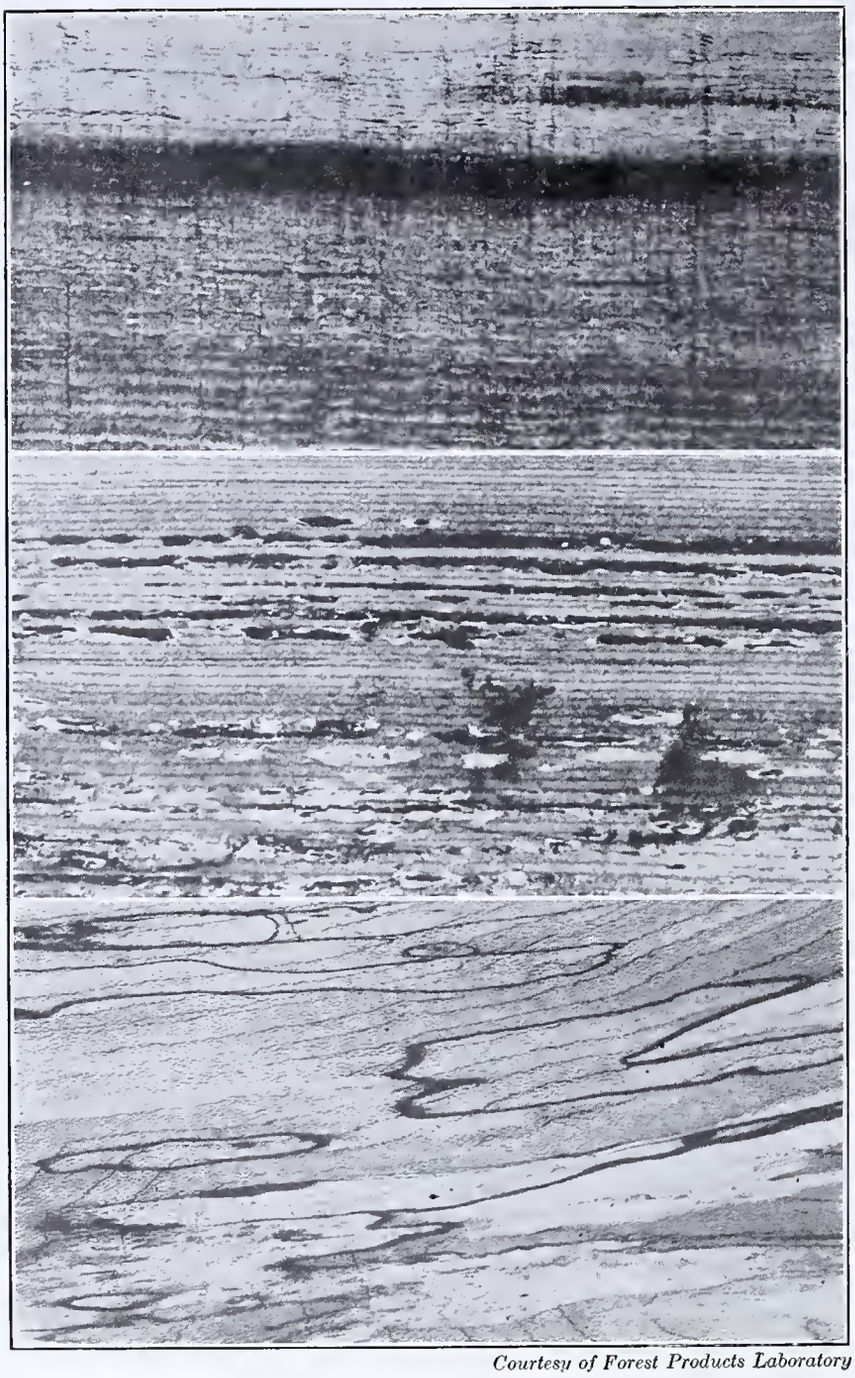
Strength in Compression Perpendicular *to the Grain*

Columns 14, 15: Fiber stress at elastic limit.

These figures indicate the greatest stress that can be applied perpendicular to the grain of wood without injury to the wood structure. It is based upon green wood.

Courtesy of New York State College of Forestry

Plate IX—Compression failure in heartwood and sapwood blocks of red gum; load was applied parallel to the grain.



Incipient decay

Advanced decay showing small pocket rot

Incipient and advanced decay and white rot

Courtesy of Forest Products Laboratory

Plate X—Decay in wood.

The value for air-dry wood is about one and three-fourths times as great as that for green wood.

Examples of its use are for estimating proper bearing areas for beams, cross-ties, etc.

Two-thirds of the fiber stress given may be used as a safe stress for any grade of structural timber.

Stiffness

Columns 16, 17: Modulus of elasticity.

Modulus of elasticity is a unit measure for wood indicating its stiffness, and is used in calculating the deflection of beams. High values indicate a high degree of stiffness with but little deflection.

Values shown are for green wood. The value of air-dry wood is approximately 25 per cent greater. One-half the values given in the table are recommended for use in the design of beams to allow for sag which takes place with time, and one-third of the values in the table for long columns. As a general rule, defects in structural timbers, such as knots, have little if any influence on the property of stiffness.

Hardness

Columns 18, 19: Load required to imbed a 0.44-inch ball one-half its diameter.

Hardness is perhaps one of the most important properties of wood. It refers to the resistance of wood to wear. It has commercial application for use in such products as flooring, paving blocks, handle stock, etc. Radial and tangential surfaces vary little with regard to their respective differences in values, and hence have been averaged and tabulated as "side hardness." End hardness is usually slightly greater than side hardness.

The value shown is for green wood. The value for air-dry wood is about 33 per cent greater.

Shock-resisting Ability

Columns 20, 21: Work to maximum load in bending.

The ability of wood to resist shock is a combination of strength and toughness. Toughness is the ability of wood to bend without breaking, and is usually determined by a combination of tests.

Probably the best examples of the commercial application of the shock-resisting ability of wood is in its use for spokes, for automobiles and cars, ax handles, etc., where wood is subjected to sudden loads.

Shearing Strength Parallel to Grain

Column 22: Shearing strength.

Shearing strength of wood is the resistance which it offers to a force which tends to make the fibers slip by, one on the other. It is an important factor in beams which are likely to fail by shearing lengthwise so that the upper half slides on the lower half when the beam is bent.

The strength value given (shearing strength) is for green wood. It represents an average of the values for radial and tangential shearing strength. The value for air-dry wood is about 50 per cent greater than for the green. The shearing strength of kiln-dry wood is greater than that of air-dry wood.

Factors Affecting the Strength of Wooden Members

Wood, as previously mentioned, has variable strength properties and, for this reason, should be carefully examined so that those factors which directly affect its strength can be controlled.

A few of the more important factors have been discussed under separate captions elsewhere. Particular attention is called to the discussions on: "The Strength of Wood," "Mechanical Properties of Wood," "Seasoning of Wood," etc.

The actual strength of wooden members depends upon the following causes, which are considered in establishing structural grading rules.

Direct Causes

Actual size and shape of the piece
Density of the wood (specific gravity)
Amounts of springwood and summerwood
Moisture content
Species of wood used
Relation of ring growth to the direction of applied force of loads
Defects: knots, type, direction or slope of grain, shakes and splits, decay, pitch pockets, compression failure, heart and pitch, extent of worm and insect damage, etc.

Indirect Causes

Locality and site in which the tree grew
Position of tree from which the wood was cut
Seasoning

Shipping Weights of Lumber

Frequently there are inquiries as to the specific shipping weight of such materials as 4/4 ash, 8/4 red gum, etc. In order to give such data, the average moisture content of stock must be known, and even then such figures only roughly indicate the shipping weights. However, it is possible to estimate closely the weight of a given quantity of lumber if its exact volume and moisture content are known.

There will be found in the discussion on various species of wood, under the caption "Unit Packages," tables for hardwood lumber, which for commercial use are sufficiently close to justify their use. This data has been calculated by the Hardwood Manufacturers Institute from *Technical Note 218* of the Forest Products Laboratory. Weights per cubic foot have been used as a basis for estimating weights per thousand board feet. These conversions have been made following a formula established by the Laboratory for adjusting moisture content and volume of the lumber. The following extract is taken from this Technical Note, and refers to the method of calculating these weights at various moisture contents and varying thicknesses:

A practical rule for estimating the weight of air-dried or kiln-dried wood at a moisture content in the neighborhood of 12 per cent, is to regard a one-half per cent change in weight as accompanying a one per cent change in moisture content. For example: Wood at eight per cent moisture content would weigh about two per cent less than at 12 per cent; while at 14 per cent, the weight would be about one per cent more than at 12 per cent.

As these estimates are based on actual volume, the weight per thousand feet of 6/4, 8/4, or other thick stock may be readily determined by knowing the exact thickness. Stock measuring

exactly one and one-half inches would weigh at the rate per thousand feet for stock thicker than 4/4 thickness of the same moisture content. It is customary to apply higher weights per thousand feet for stock thicker than 4/4. This is due to the fact that the thicker stock usually carries a greater amount of moisture than 4/4, but where the moisture content is the same. weights per thousand feet board measure should not materially vary on account of thickness.

Approximate shipping weights for softwood lumber have been obtained from data supplied by the various regional lumber manufacturers' associations.

Table 162, "Estimated Transportation Charges per Thousand Board Feet at Given Weights and Rates," will be found useful in figuring approximate freight rates.

Deterioration of Wood

Decay

Unfortunately, wood is subject to decay and other deterioration. Untold quantities of lumber and wood products, much of which could be saved through proper handling, seasoning, and treatment prior to ultimate fabrication, are lost annually.

Decay is simply the conversion of certain wood substance into food by some of the lower forms of plant life. It is caused by wood-destroying organisms known as fungi, which have the power of sending out fine, threadlike filaments penetrating the wood in all directions, and gradually breaking down the wood structure as the cell walls are dissolved. Such a process eventually results in the entire destruction of the piece, and is termed "decay." Lumbermen refer to decay as heart rot, sap rot, etc.

Often there are seen on logs, pulpwood, and lumber, so-called "toadstools." These are the fruiting bodies of the organisms which have the power of sending out microscopic spores (or seeds) capable of continuing the life cycle of the fungi, providing contact is made with wood and conditions are favorable for its growth.

Decay is spread by infestation of new wood by these spores or by close contact of sound wood with infested wood.

The following conditions are necessary for the growth of fungi:

Food (wood substance)
Moisture
Air
Favorable temperature

In order to prevent decay, it is necessary to deprive the fungi of one or more of these four requirements. The most effective means of preventing decay, and the principle upon which wood preservation is based, is to poison the food supply of the fungi.

Decay must be carefully watched for in the inspection and acceptance of lumber. Often certain stages of decay are extremely hard to discover, particularly in rough lumber.

Decay has been specifically treated in grading rules for hardwood and softwood lumber. Attention is called to the following definition of decay as given in *Rules for the Measurement and Inspection of Hardwood Lumber—Cypress, Veneer, Thin Lumber, and Plywood,* issued by the National Hardwood Lumber Association:

Decay and Peck.—Decay is a disintegration of the wood substance, due to the action of the wood-destroying fungi. The words "dote" and "rot" mean the same as decay.

Incipient decay is the early stage of decay in which the disintegration has not proceeded far enough to soften or otherwise change the hardness of the wood perceptibly. It is usually accompanied by a slight discoloration or bleaching of the wood. (See Plate X.)

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Advanced (or typical) decay is the older stage of decay in which the disintegration is readily recognized because the wood has become punky, soft and spongy, stringy, ring-shaked, pitted, or crumbly. Decided discoloration or bleaching of the rotted wood is often apparent.

Pocket rot (or peck) is typical decay which appears in the form of a hole, pocket, or area of soft rot, usually surrounded by apparently sound wood.

How to Prevent and Minimize Loss through Decay

Direct

By eliminating one or more of the factors which are favorable to its growth, decay can be greatly reduced and held in check. This can be accomplished in a number of ways:

By the chemical treatment of wood in accordance with standard accepted processes and with standard preservatives

By the application of recommended building practices in construction

By the use of woods which are naturally resistant to decay

By proper piling of lumber for air-seasoning, in accordance with recommended practices

By yard sanitation

By kiln-drying, which will destroy any organism already active in wood and prevent its further destructive action

Such wood will remain sound unless exposed to fungi spores under conditions favorable to their growth. Air-drying will not destroy fungi but will keep them dormant over a period of years until moisture conditions favorable to their growth are prevalent.

Relative Resistance of Heartwood of Different Species when Used under Conditions which Favor Decay

Many of our woods are particularly resistant to decay attacks. Sapwood is more susceptible to fungi attack than heartwood. This is probably due to the existence in the former of greater moisture and better food conditions. For this reason heartwood is often specified for use under conditions where decay is likely to take place.

The Forest Products Laboratory has carried on considerable research with regard to decay problems. The following extract is taken from a report issued by this organization:

The decay resistance or durability of heartwood in service is greatly influenced by differences in the character of the wood, the attacking fungi, and the condition of exposure. Therefore, widely different life lengths may be obtained from pieces of wood cut from the same species or even the same tree and used under apparently similar conditions.

The resistance of certain species is due to natural oils or preservatives found in the heartwood. The quality of these oils varies and a consequent variation occurs in the life of wood even within the same species. Wide differences in this respect may be found even in different parts of a single log, with resulting differences in decay resistance. In the pines and Douglas fir occasional pieces are very resinous or pitchy. Wood thus saturated with pitch or resin is extremely resistant to decay and gives very long life in contact with the ground or in other places where conditions favor decay.

General statements comparing the relative decay resistance of different species are only estimated. They cannot be exact and may be very misleading if understood as mathematically accurate and applicable to all cases. They may be very useful, however, if understood as approximate averages only, from which specific cases may vary considerably, and as having application only where the wood is used under conditions which favor decay.

The following classification of common native species is subject to the limitations mentioned above:

From such service records as are available, supplemented by general experience, the heartwood of the following species may be classed as durable, even when used under conditions which favor decay: the catalpas, practically all of the cedars, chestnut, southern cypress, the junipers, black locust, red mulberry, Osage-orange, redwood, black walnut, and Pacific yew.

Similarly, the heartwood of aspen, basswood, cottonwood, the true firs (not Douglas fir), and the willows when used under conditions which favor decay, may be classed as low in decay resistance, while the heartwood of Douglas fir, red gum, western larch, chestnut oak, southern yellow pine, and tamarack may be classed as intermediate. The heartwood of dense Douglas fir, honey locust, white oak, and dense southern pine may also be classed as intermediate, but nearly as durable as some of the species named in the high durability group. The heartwood of the ashes, beech, the birches, the hemlocks, sugar maple, the red oaks, and the spruces may be considered on the border line between the intermediate and nondurable groups, and cannot with assurance be placed wholly in either group.

The drain upon our resistant woods has been heavy, and in many instances the supply has been reduced to such an extent that values have increased to proportions precluding their use for certain purposes.

A proper knowledge of the decay resistance of wood, together with the correct use of species, will, in a great measure, reduce waste. Many untreated species now in use could be made just as serviceable as the decay-resisting species or even more, if given accepted standard wood preservative treatment.

Wood Preservation

Wood preservation is the science of protecting wood from decay and insect attack, and of processes developed as the result of long study and research.

The principle underlying wood preservation is the finding of a substance which will not be injurious to the wood itself or prevent its future use, but which will poison and render the wood substance unfit as food for wood-destroying organisms.

Indirectly, wood preservation tends to reduce checking, splitting, and other shattering of the wood structure by reason of weather exposure that would seriously affect untreated lumber. While it originally had but one purpose, to increase the life of timber in service, it is now generally recognized as having an additional purpose, i.e., to conserve standing timber by eliminating the need for extensive cutting to replace decayed wood. The successful accomplishment of the former purpose has justified its claim to the latter.

The use and importance of treated lumber is increasing constantly. It is suggested that matters pertaining to preservative treatments or problems relative to decay should be referred to the Forest Products Laboratory, American Wood Preservers' Association, and National Committee on Wood Utilization. (See general list of Associations for addresses.)

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The following list of specifications and standards, revised and accepted to date, in regard to preservative treatments and preservatives, have been taken from the Wood Preservers' Manual issued by the American Wood Preservers' Association, under date of 1929. They can be secured from this Association. (See general list of Associations for addresses.)

Standard Method of Analysis for Zinc Chloride.
Standards for the Purchase and Preservation of Treatable Timber.
Standard Definition of Creosote.
Standard Definition of Tar.
Standard Specifications for Creosote Oil for Ties and Structural Timbers.
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Standard Float Test of the Residue in Creosote Oil.
Standard Method for the Determination of Coke Residue in Creosote Oil.
Standard Method for the Determination of the Amount of Material Insoluble in Benzol.
Standard Method for the Determination of the Specific Gravity of a Fraction of Creosote Oil.
Standard Method for the Determination of the Amount of Water in Creosote Oil.
Standard Distillation of Creosote Oil.
Standard Definitions of Processes.
Volume and Specific Gravity Factors for Creosote Oil.
Standard Volumes of Piles and Poles.
Standard Specifications for Preservatives for Flooring and Paving Blocks.
Standard Specification for Creosoted Wood Block Street Paving.
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Standard Specification for the Preservative Treatment of Douglas Fir Ties by Pressure Processes.
Standard Specification for the Preservative Treatment of Yellow Pine Piles by Pressure Processes.
Standard Abridged Volume Correction Table for Petroleum Oils.
Standard Specification for the Preservative Treatment of Douglas Fir Piles by Pressure Processes.
Standard Specification for the Preservative Treatment of Trunking and Capping by Pressure Processes.
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Surface Coatings

Application of paint has done much to increase the life and service of wood against destructive agencies, but when once incipient decay has started it progresses rapidly and ultimately destroys entirely the member it attacks.

Surface coatings such as paints and varnishes have little or no direct value in rendering wood resistant to insect attack and decay except to prevent spores reaching the wood. Paint is commonly thought of as a decorative medium and protection. It does not create the conditions necessary to render wood unfit for food for wood-destroying organisms, nor does it kill such fungi. In few instances do paints and varnishes penetrate the wood, and quite often decay is going on and is not apparent under the surface coating until the whole member gives way.

Paint and varnish are of inestimable value, however, in use for decorative purposes, in rendering surfaces less likely to retain dirt, in preventing deterioration of the wood from weather, and in slowing up the absorption of moisture, thus minimizing the warping and twisting of the wood.

Decay will not develop on the painted surfaces of the wood, but the action will continue if already present in the wood itself, and other conditions are favorable.

TABLE 3

STRUCTURES IN WHICH TREATED MATERIAL SHOULD BE USED

(Courtesy of American Wood Preservers Association)

Use	*Where Used*	*Members Treated*
Railroad	Roadbed	Crossties, switch ties, tie plugs, crossing plank.
	Heavy and light construction	Bridge and trestle timbers, piling, station platform substructures, flooring, overhead highway, and footbridges, timbers used in sill and foundations, blocking for buildings, timber wall plates, turntables, circle walls, inspection pits, culverts, coaling stations, water tanks, snow fences, cattle chutes, stock-pen posts, drain boxes, signal trunking and capping, fence posts, telegraph, telephone, and signal poles, signposts, car decks and framing, conduit lumber, etc.
Industrial construction	Paper, textile, and chemical mills, laundries, bakeries, and creameries.	Framing, roof timber, subfloors, joists and rafters, flooring blocks, window sash and frames.
	Factories and miscellaneous structures where excessive humidity and high temperatures prevail.	(The use of preserved members depends entirely upon conditions.)
	Marine work: wharves, docks, barges, bulkheads, breakwaters, causeways, board walks, and loading docks.	Piling and substructure, flooring, bulkheading, and sheet piling.
	Miscellaneous: athletic stadia, band stands, pavilions, open-air dance halls, etc.	Seating, superstructure, flooring, foundation posts, subflooring.
Road construction	Road building: bridges and culverts.	Highway posts, signs, bulkheads for retaining walls, permanent wood construction, guard rails, bridge floors, etc.
Mine construction	Head frames, shaft houses, breakers, tipples, tramways, ore bins, coal bunkers, trestles, flumes, concentrating mills, stamp mills, mine buildings, various shops, mine cars, tanks, conduits, shafts, and permanent haulage ways.	Pillars, posts, crossties, shoring, cribbing, heavy dimension and underground timbering.
Public utilities	Telephone and telegraph and power line construction, right-of-way construction, sheds, buildings.	Cross arms, poles, posts, conduits, ties, crossings.
Agricultural structures	Barns, sheds (milk, wagon, storage), chicken houses, dipping tanks, water tanks, silos, and hog houses.	Posts, sawed fencing, snow fences, foundations, sills, stanchion stock, flooring, plates, joists, studding, miscellaneous building lumber.
Residential structures[1]	Apartment houses, semidetached or detached houses, small outdoor buildings, and garages.	Foundations and sills, over unexcavated spaces, subfloors, joists, shingles, outdoor steps, and porches.

Sap Stains of Wood

Sap stains and other stains on wood often result in considerable degrade and, quite often, in the total loss of lumber for specific uses. To a large degree staining can be minimized by proper handling and care. It occurs in both the log and the lumber.

[1] It is not essential that all lumber used in residential structures be treated. It more particularly applies to wooden members which are in direct contact with the ground, excessive humidity and moisture, where insect attack or decay may develop.

Courtesy of Forest Products Laboratory

Plate XI—Surfaced softwood lumber showing the effects of blue stain. In many cases stain prohibits the use of such lumber where natural finish is required.

Courtesy of The National Committee on Wood Utilization

Plate XII—A well piled stack of lumber. Note the proper pitch and well constructed roof. Such stacks assure lumber that is well air-seasoned and with minimum degrade.

Research has indicated that most of the discoloration of wood is caused by minute organisms, a form of plant life known as fungi. Another type of stain is the result of chemical reactions and, though not quite as prevalent, it nevertheless causes considerable damage and degrade to lumber of certain species.

Stains are produced in several ways: namely, through chemical action and through fungi.

The following represent important types of stain produced chemically:

Kiln Burn

A dark brown staining, scorching, or actual charring of kiln-dried stock, caused often by high temperatures.

Kiln Brown Stain

Yellow to dark brown stain developed during kiln-drying of sugar pine, Pondosa pine, and California white pine. Quite often this damage is referred to as "kiln burn" and "scorch."

Machine Burn

A brown discoloration found in small areas on finished stock. The area is often scorched or burned during surfacing or machining, particularly when a board is caught between rollers or pinched in saws. The heating is developed by friction of the planer knives, saws, etc.

Water Stain

Yellow to dark brown surface stain on lumber, common on light colored wood. It is frequently found in yard piles where water has leaked through into the piles. Usually planes off in surfacing.

Yard Brown Stain

Yellow to dark brown stain in air-seasoned white pine, sugar pine, Pondosa and California white pine.

Stains Produced by Fungi

Numerous stains produced by fungi take on different colors—yellow, pink, red, purple, blue, etc. Some attack the heartwood and others the sapwood. Quite often, if the stain has not progressed too deeply, it can be surfaced off.

Molds and stains do not seriously affect the strength properties of wood, as they do not attack the cell walls. *Blue stain is not an early stage of decay.* It does, however, affect the use of lumber if natural finish is required. (See Plate XI.)

The following is a list of the more common stains caused by fungi:

Black stain	Gray-olive stain	Pink stain
Blue stain	Green stain	Yellow stain
Brown sap stain		

Mineral Streaks

Mineral streaks in various woods, particularly in maple, are commonly spoken of as "mineral stain." They are also found in poplar, soft maple, buckeye, etc. Many lumbermen believe these stains or streaks are caused by the absorption of iron or copper salts through the roots of the tree. In reality, study has shown that the areas contain minute colorless

threads of fungi within the cells. The discoloration is apparently an early stage of some common heart rot of maple.

It has been found that mineral streaks are extremely hard and tend to dull saws and cutter knives. The wood often opens up around this area and frequently develops "hair" checks in the wood.

The staining of lumber can be avoided and minimized in several ways:

Proper piling for air-seasoning
Kiln-drying
End coating and spraying with chemicals
Dipping in chemicals
Pressure steaming

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(See general Bibliography and general list of Periodicals for publishers' addresses.)

The Seasoning of Wood

Moisture Content

The chief aim in seasoning wood is to remove all or such parts of the moisture in wood which if left would affect or interfere with its fabrication and subsequent use. The Forest Products Laboratory, in its recent report entitled *Kiln Drying Handbook*, offers the following information in regard to the moisture in wood:

The amount of moisture to be removed depends upon both the quantity present and the service for which the wood is intended. It is rarely necessary or even desirable, except in test pieces, to remove all the moisture; that is, to bring about an oven-dry condition.

Moisture in wood is commonly called sap, a word that has several meanings. Since lack of a precise definition causes much confusion, this bulletin will avoid the use of the term "sap."

The moisture in both sapwood and heartwood consists almost entirely of water, although it does contain small percentages of organic and mineral matter. In the sapwood these substances are principally sugars of various kinds, and in the heartwood they include tannins, coloring matter, and various other chemicals. For present purposes, sap will be considered as water only.

Water occurs in wood in two distinct forms, usually called free water and imbibed water. The free water is in the cell cavities, and the imbibed water is in the cell walls. Imagine each cell of a piece of wood to be a small bucket made of some absorbent material. When such a bucket is filled with water, a certain quantity of the water is absorbed by the sides and bottom, in addition to the pailful which they inclose. The pailful is free water; that absorbed by the walls is imbibed water, and the sum of the two represents all the water the bucket, or the cell, can hold. A portion, or even all, of the free water can be removed from the cell without changing the amount of imbibed water in its walls, but when it has become empty, further draining removes water from the walls themselves and they begin to dry out. The point at which the cell becomes empty while the walls are still full is called the "fiber-saturation point"; it has a very important bearing upon the process of drying, and for that reason will be discussed more fully later.

In most living trees both heartwood and sapwood contain some free water. The amount, which depends on a number of factors, varies considerably, although sapwood almost always has more moisture than heartwood. Similarly, the butt may contain much more than the top, as is evidenced by the sinker stock of redwood and of sugar pine. The season of the year in which trees are felled may have some influence upon the moisture in their sapwood, although this influence is never important.

Both species and place of growth have an important bearing upon the amount of moisture in living trees. Those growing in swampy regions are likely to contain much more moisture, and also are likely to be more difficult to dry, than similar upland species. The oaks are an excellent illustration of this fact. On the other hand, certain species contain comparatively large amounts of water, even though they normally grow under reasonably dry conditions. All variations such as these must be taken into consideration in the drafting of drying schedules and in actual drying operations.

TABLE 4

Required Dryness of Lumber for Various Uses

Group	*Moisture Per Cent at Time of Manufacture*
Furniture, musical instruments, auto bodies	5 to 7
Flooring	5 to 6
Fixtures, interior trim, doors	6 to 8
Vehicle stock	10 to 15
Wheel spokes	3 to 5
Last blocks, wooden heels	5 to 7
Knife handles	4 to 6
Ball bats, etc	7 to 10
Boats (finish)	8 to 10
Railway freight cars	10 to 12
Shingles, house siding	15 to 20
Construction lumber	15 to 25
Stock to be bent	15 to 20
Veneer for shipping	10 to 12
Veneer for gluing	4 to 6

Why Wood is Seasoned

The basis, and perhaps the chief reason, for the seasoning of wood is to increase its usefulness.

Seasoning consists primarily in reducing the moisture content of wood, thus making it more adaptable for fabrication and use. This is accomplished by subjecting wood to heat circulation and humidity; if possible, under control by air-seasoning or kiln-drying.

Seasoning may be carried out at the mill, distributing point, or fabricating plant. Its purposes are the following important accomplishments:

To reduce weight, thus effecting savings in the transportation and handling costs

To place lumber in condition for shipment without danger of staining, mildewing, or deteriorating in transit

To minimize degrade of stock through controllable measures

To increase generally the strength of the wood

However, some of the strength values, such as impact strength, or ability to resist shocks, may be decreased. In large size members, containing knots and other defects, the increase in strength may be largely offset by further defects, such as checks, which develop in seasoning. Recommended practice, therefore, is to base timber stresses on green strength, making some allowance for higher stresses for timbers used in dry or protected locations.

To reduce insect damage and to stop the action of stains, mold, and other fungi attack

To reduce or eliminate the shrinkage of wood in use

Two distinct methods of seasoning are used: air-seasoning and kiln-drying.

Air-seasoning

In air-seasoning, natural atmospheric conditions of sunlight, heat, wind circulation, pile circulation, and natural humidity, as well as methods of piling, etc., are taken advantage of, with the object of reducing the moisture in wood.

The process may be slow or rapid, depending entirely upon climatic conditions, seasonal zones, etc.; therefore, air-seasoning practices vary greatly.

Probably the major part of the lumber annually produced is *air-seasoned* in the sawmill yard. Some portion of this lumber is kiln-dried, following the yard seasoning—probably over half of the hardwoods and a rather small proportion of the softwoods. Softwoods are air-dried in order to bring the lumber to a dryness suitable to the use for which the stock is intended. Most of the rekilning is done at factories, though a great deal of softwood goes into various factory uses where more thorough drying than good air-drying is not needed. Hardwood stock for sawmill kiln-drying is generally taken from the yard in a partly dried condition, particularly when the sawmill is shut down. Softwood stock, almost without exception, is dried green from the saw without being stacked in the yard at all.

Much of the lumber that is air-dried could be kiln-dried with less loss from degrade and at an actual lower cost, all factors considered. In some thick hardwoods kiln-drying is so slow that it costs more than air-drying. Kiln-drying is gradually replacing air-drying each year as dry-kiln equipment is expanded. But the replacement process is slow, even in fields where the advantages of kiln-drying over air-drying are most obvious; for kiln-drying requires a large investment in dry-kiln equipment, which in some cases might not be justified by the operating life of the plant, as limited by its timber supply. Air-drying requires only suitable yard space, and a moderate investment in pile foundations, stickers, etc., all of which consist of sawed material that the mill itself can supply, and usually from defective and unsalable stock. Air-drying requires the tying up of capital in lumber piles for the period required for drying; the kiln-dried material can be rapidly put into a marketable condition of seasoning.

In some species of wood, as in cypress, air-drying is the preferred method of seasoning, and many of the mills having dry-kilns use them for final drying of air-dried stock. In the hardwoods in general, while kiln-drying could be done green from the saw, with considerable

reduction of seasoning losses, the present practice of operating the mill without dry-kilns and air-drying the product, is firmly established. Most of this lumber is also kiln-dried at fabricating plants. With a very few exceptions among the leading mills, both dry-kilns and planing-mill equipment have been added following a policy of marketing the product in more refined forms than as rough-dry lumber.

TABLE 5

Drying Periods for One-inch Lumber

Species of Wood	*Days to Air-season to 20 Per Cent Moisture*[1] *(Approximately)*	*Days to Kiln-dry from 20 Per Cent to 6 Per Cent*[2]	*Days to Kiln-dry from Green to 6 Per Cent*
White oak	270	6 to 12	20 to 45
Red oak	210	4 to 8	16 to 26
Swamp oak	360 to 400	6 to 14	20 to 50
Birch	150 to 200	5 to 8	11 to 15
Beech	150 to 200	6 to 8	12 to 15
Maple	150 to 200	5 to 7	10 to 14
White ash	70 to 100	4 to 7	12 to 18
Red gum	100 to 160	5 to 7	16 to 24
Hickory	150 to 200	8 to 14	20 to 40
Elm	80 to 130	4 to 6	10 to 15
Yellow poplar	40 to 70	4 to 6	10 to 13
Basswood	30 to 60	3 to 5	7 to 10
Cherry	150 to 200	5 to 7	10 to 12
Chestnut	85 to 125	4 to 8	8 to 12
Walnut	120 to 170	6 to 8	12 to 18
Mahogany	70 to 110	4 to 7	12 to 16
Yellow pine	40 to 70	1½ to 3	3 to 6
Douglas fir	40 to 70	1½ to 3	3 to 6
White pine	30 to 60	2 to 5	5 to 8
Cypress	200 to 275	4 to 6	6 to 10
Redwood	60 to 180	4 to 7	10 to 15
Western red cedar	50 to 140	4 to 7	....

The following suggestions are given by the Forest Products Laboratory in regard to recommended practices toward efficient air-seasoning of lumber (*Kiln Drying Handbook*):

Piling correctly for air-seasoning must accomplish a number of things. It must provide proper air circulation, it must offer suitable protection from sun and rain, and it must keep the boards straight and flat while they are drying. If these things are accomplished, the best drying will result, and drying defects will be at a minimum. Among such defects may be mentioned stain and decay, end and surface checking, and warping.

No one rule will apply to all weather conditions and to all classes of stock. Often, however, no special precautions have to be taken to prevent too rapid drying, while on the other hand every effort should be made to secure ample air circulation through the pile.

The following general principles will apply to most seasoning yards:

Foundations for lumber piles should be firm and level in one direction and properly pitched in the other. Standing well above the ground, preferably high enough to give a 12-to 18-inch clearance above the ground at the lowest point, they should provide adequate support for each row of stickers and keep the lumber entirely free from decay. Free circulation of the air under the stringers and around all parts of the foundations must be secured.

[1] The time to air-dry varies with the climate and season when it is placed on sticks and the manner in which it is piled.

[2] The time required to kiln-dry will vary with the drying system used, the use to which it is to be put afterwards, and the quality of lumber (grade).

Pile widths should be kept small when possible. A 6-foot width is excellent for most hardwoods. Softwood piles can usually be wider—8 feet and upward. When softwoods are stickered with stock (self-stickered) instead of with special stickers, the width of the pile will of course equal the length of the stock. Low grades of softwoods, especially in narrow widths, are often self-stickered.

Spaces between adjacent piles should be ample—4 feet if possible—and spaces between rows of piles should average 8 feet or more; main alleys should be about 16 feet wide.

Stickers should be of clear, dry stock, entirely free from both stain and decay, not less than $^7/_8$ inch thick, and from $1^1/_2$ inches wide or more for hardwoods, to 4 inches or less for softwoods. They must all be of the same thickness. The spacing between rows of stickers will vary from 2 feet minimum, for green hardwoods such as red gum, to 6 or 8 feet maximum, for softwoods. Under most conditions, 8 feet will be found too wide a spacing even for softwoods. Front and rear stickers should project an inch or so beyond the ends of the boards.

The piles should pitch forward about 1 inch in 12 inches, and should slope downward towards the rear the same degree. (See Plate XII.)

Roofs for lumber piles, which ordinarily are made of common grades of lumber, must provide protection from sun and rain. Such roofs often are used repeatedly, but in some instances are disposed of after they have been used a few times. They should be made of two overlapping layers of boards, should project at least a foot on all sides of the pile, and may, if desired, be given a greater slope than the pile itself. This may be done by elevating them above the top of the pile 4 inches at the rear and 8 inches at the front. In windy localities they may have to be anchored to the pile.

Spaces between boards in the same layer should usually be from 2 to 4 inches. As far as possible, the corresponding spaces in successive layers should be in vertical alignment. In large piles a single central chimney or two or more side flues may be formed by the method of piling in order to hasten drying. The lower parts of piles usually dry more slowly than the upper parts, and it is often desirable to open up the lower portions to counteract this tendency.

In general, overhanging ends of long boards should be avoided. To do this, when it is necessary to pile boards of uneven length together, they should be box-piled, either exactly as described for kiln work, or possibly with some slight modification of that method. In any event, both ends of each board must be supported, and no board should be placed on a sticker that is not itself supported by a board underneath it.

If drying is too rapid, as evidenced by excessive checking, the circulation should be cut down by using thinner stickers, wider piles, or narrower spaces between boards; by spacing the piles closer together; or by a combination of these means. If drying is too slow, as evidenced by staining, the opposite course should be pursued.

Bibliography

The following books and articles may prove helpful to readers desiring further information.

AIR-SEASONING AND HANDLING OF LUMBER

There are no books dealing exclusively with air-drying, but it is given some attention in the following:

The Properties and Uses of Wood—ARTHUR KOEHLER. Chapter VII is devoted to air-drying, and Chapter VIII to kiln-drying.

Lumber—RALPH CLEMENT BRYANT. The first 20 pages of Chapter X give some practical suggestions on air-drying.

The following Technical Notes of the Forest Products Laboratory relate to air-seasoning:

A-1. *Hints on Storing Timber to Prevent Decay*
D-10. *Piling Oak Dimension to Reduce Season Checks*
219. *Stickering of Western Softwoods for Air-seasoning*

Most of the research in air-drying of lumber has been done under a project inaugurated in 1921, work in the Far West being conducted by representatives of the Forest Service, and in the middle and eastern United States by the staff of the Forest Products Laboratory. The first three surveys listed below are obtainable only from *The Timberman*, in back numbers or in reprints:

"Air Seasoning of Lumber in the Inland Empire"—S. V. FULLAWAY and E. E. HUBERT—*The Timberman*, March, April, May, June, 1925.

"Air Seasoning of Lumber in the California Pine and Redwood Region"—C. B. GREEN—*The Timberman*, Oct., Nov., Dec., 1925.

"Air Seasoning of Lumber in the Douglas Fir Region"—HERMAN M. JOHNSON and WILLIAM H. GIBBONS—*The Timberman*, Nov., Dec., 1926, Jan., 1927.

The following survey reports were made by staff men of the Forest Products Laboratory:

Air Seasoning of Southern Yellow Pine Lumber—L. L. DeFlon. Published as a booklet by the Southern Pine Association, 1924. Chiefly a comparison of piling endwise or sidewise to the alley, with little difference in results.

Problems in the Seasoning of Southern Hardwoods—W. K. Loughborough and E. E. Hubert. Mimeographed report distributed to coöperating manufacturers, March 3, 1926. Article by Loughborough with same title also published in *Southern Lumberman*, Dec. 20, 1924.

(See general Bibliography and general list of Periodicals for publishers' addresses.)

Kiln-drying of Wood

The subject of kiln-drying has been so thoroughly covered in the trade press, laboratory reports, and by experts, that it is almost unnecessary to dwell at length upon the subject. In the bibliography following this discussion are shown the names of a few publications and reports which treat kiln-drying and which are especially valuable for reference work, due to the thoroughness and the practical manner in which they cover the field.

Kiln-drying is a necessary process where a low moisture content is imperative in the stock to be used. It is now often accomplished as the wood comes green from the saw, but more generally the stock is partially seasoned first.

Improper kiln-drying may ruin the value of wood; even more often it is responsible for serious degrade. Proper kiln-drying does not in any way injure the properties of wood. Wood thoroughly seasoned and dry is stronger than green stock. (See Plate XIII.)

Casehardening, excessive checking, warping and twisting, and honeycombing are the results of improper seasoning.

Thoroughly seasoned wood and wood of low moisture content does not decay. Further, damage and degrade consisting of sap stains, molds, and insect activities, frequently encountered in wood, are prevented.

The time required to season wood can be considerably shortened by the use of dry-kilns. Dry-kiln schedules have been developed which are of utmost importance if properly dried stock is to be produced. Careful study of these drying schedules will point out methods of shortening drying periods, and may prove to be more economical than many schedules now in use.

Good kiln-drying practice causes less lumber degrade than the best air-drying practice. The importance of this fact is obvious, since it is claimed by some authorities that the average loss per thousand feet in air-seasoned lumber because of degrade in drying, can be cut down at least two-thirds by improved methods of seasoning.

Kiln-drying speeds up the lumber turnover in a yard. It reduces yard space, handling costs, and many other factors which are common in the seasoning problem. (See Plate XIV.) The modern dry-kiln produces heat, together with moisture and circulation to evaporate the moisture in wood. These factors must be controlled to insure efficient kiln-drying.

Yard seasoning of lumber on sticks goes through the same process as lumber in the kiln, but in a much less vigorous degree. It, therefore, requires a longer period of time. However, it can never be brought below a moisture content controlled by the temperature, humidity, etc., of the atmosphere.

Numerous dry-kilns, all of which have their advantages or disadvantages, are on the market. They were designed after careful study by dry-kiln experts, and if handled correctly may be counted upon to dry lumber economically and practically.

Bibliography

The following books and articles may prove helpful to readers desiring further information.

KILN-DRYING OF LUMBER

The Kiln Drying of Lumber—HARRY DONALD TIEMANN.
The Kiln Drying of Lumber—ARTHUR KOEHLER and ROLF THELEN.
Seasoning of Wood—JOSEPH B. WAGNER.
The Seasoning and Preservation of Wood—ERNEST G. BLAKE.
Practical Kiln Drying—E. U. KETTLE.
Manual of Timbers of the World—ALEXANDER L. HOWARD.
Kiln Drying Handbook—ROLF THELEN.
Manual of Design and Installation of the Forest Service Water-Spray Dry Kiln—L. V. TEESDALE.
The Theory of Drying and Its Application to the New Humidity Regulated and Recirculating Dry Kiln—HARRY D. TIEMANN.
The Control of Stain, Decay, and Other Seasoning Defects in Red Gum—L. V. TEESDALE.
The Seasoning of Wood—H. S. BETTS.
Effect of Kiln Drying, Steaming, and Air Seasoning on Certain Fungi in Wood—Dept. of Agriculture Bulletin 1262, August, 1924.
Dry Kiln Practice—H. L. HENDERSON. This bulletin is a practical treatise on the kiln-drying of lumber, and will be of great help to kiln operators.

(See general Bibliography for publishers' addresses.)

Methods of Determining the Moisture Content of Wood

Sample Piece Method

As mentioned previously, the moisture content of wood is of utmost importance to the consumer. In order to give a practical and simple method of determining moisture content in wood the following *Technical Note* (*B–11*) issued by the Forest Products Laboratory at Madison, Wisconsin, is given:

(1) Select a representative sample of the material
(2) Immediately after sawing, remove all loose splinters and weigh the sample
(3) Put sample in an oven maintained at a temperature of 212 degrees Fahrenheit (100 degrees Centigrade) and dry until constant weight is attained
(4) Reweigh the sample to obtain the oven-dry weight
(5) Divide the loss in weight by the oven-dry weight and multiply the result by 100 to get the percentage of moisture in the original sample. Thus,

$$\text{Percentage moisture} = \frac{(W - D)}{D} 100$$

where

W = original weight as found under 2 above
D = oven-dry weight as found under 4 above

First Step—

If possible, the sample should be taken from near the center of the piece. Wood gives off, or takes on, moisture more rapidly from the end grain than from side grain; as a result, there may be considerable difference between the moisture content of the end and the center of a stick. For this reason, a sample taken from within about a foot of the end of a long board may not be representative.

Short pieces of wood dry out much more rapidly than longer ones. In order to reduce the time required for drying, therefore, the length of the sample in the direction of the grain should usually be about 1 inch. With material 1 inch square or less in cross-sectional area, however, a sample over 1 inch long is generally desirable, and the length in this case may be chosen so as to give the sample a volume of 2 or more cubic inches. The other dimensions may be equal to the cross-section of the board from which the sample is taken.

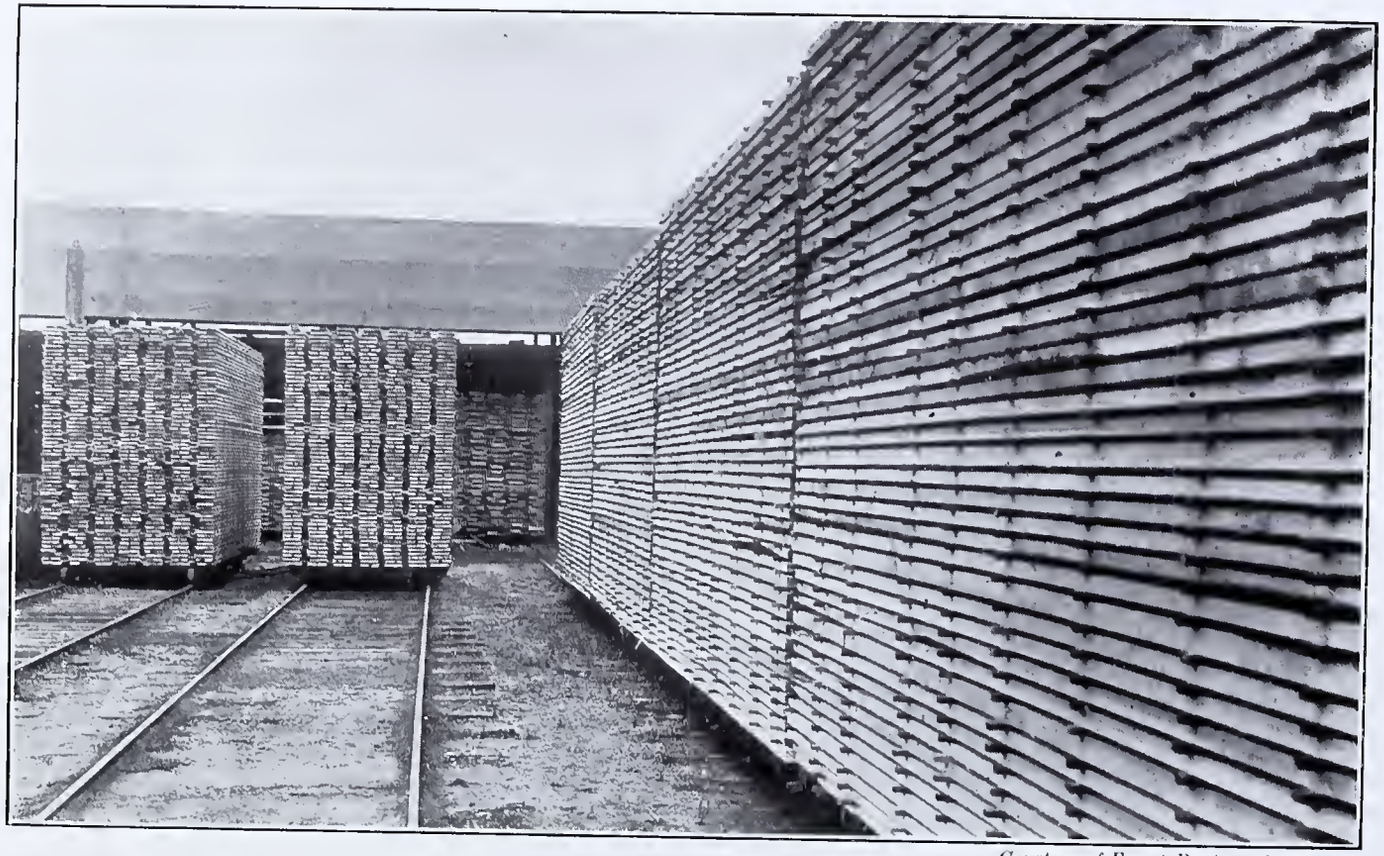
Second Step—

It is important that the weight be taken immediately after the sample is cut, for the material is subject to moisture changes on exposure to the air. The degree and rapidity of change are dependent on the moisture content of the piece and the air conditions to which it is exposed.

In order to insure good results the weights should be correct to within at least one-half of one per cent.

Courtesy of Forest Products Laboratory

Plate XIII—Typical collapse, as shown above, is due to improper kiln-drying. (Illustration shows ends of two boards.)



Courtesy of Forest Products Laboratory

Plate XIV—Quite often lumber is unloaded from the car directly onto kiln trucks. These loaded trucks are in temporary storage ready for the dry-kilns.

The metric system of weights is very convenient in making moisture determinations.

The kind of scales to be used, and the size of smallest graduations necessary to insure the specified accuracy, will depend on the weight and, consequently, the size of the sample, and the kind of wood. Small spring postal scales reading to one-half an ounce, are not suitable for accurate weighing of small moisture samples. (See Plate XV.)

Third Step—

When placed in the oven for drying, the sample should be allowed free access of air. The oven should have some ventilation, thus allowing the evaporated moisture to escape. A thermometer should be provided by which the temperature can be ascertained at any time. The temperature should at no time exceed the boiling point of water, or distillation of the wood may take place and erroneous results be obtained.

From 24 to 96 hours of oven-drying may be required for the sample to reach a constant weight, depending on the size and kind of wood, and the amount of moisture the sample contains.

Fourth Step—

As in the case of the first weight taken, it is essential that the sample be weighed soon after being removed from the oven.

Fifth Step—

A typical example of the computation necessary for determining the percentage of moisture is given below:

A 2 x 2 x 1″ sample of air-dried Sitka spruce weighed 30.8 grams. The sample after oven-drying weighed 27.5 grams. Find the moisture content of the sample.

$$\text{Percentage moisture} = \frac{(30.8 - 27.5)}{27.5} \times 100 = \frac{330}{27.5} = 12 \text{ per cent}$$

Sample Board Method

Many fabricators have adopted the sample board method of determining the moisture content of a kiln load during its drying period in the kiln.

Instead of making moisture tests on pieces all through the run, much time can be gained and more accurate information obtained by using this method.

The following description is taken from *Dry Kiln Practice*, by H. L. Henderson, New York State College of Forestry, Bulletin 16, July, 1925:

This method consists in preparing a sample board two feet long and cut from the same board that was used to make the moisture per cent determinations at the beginning of the drying. (See Illustration 4.) It should not be taken closer than two feet from the end of the board.

Coat both ends with a moisture-resisting paint such as pitch, asphaltum, or a mixture of rosin and lamp black, and then weigh on a set of platform scales, and mark weight on the sample board. (Barrett Company's "Everjet" paint, and Ohmlac Paint & Refining Company's 455 C kiln paint, are also recommended.)

From the small moisture test piece the percentage of water in the board has been determined, and by using this per cent the oven-dry weight of the sample board can be obtained. The process consists of adding one hundred to the percentage and dividing it into the original weight of the sample board. The result is the calculated oven-dry weight of the board, which is marked on the board. The sample board is then placed in the lumber piled in the kiln, and dried along with it. (See Illustration 5.)

When it becomes desirable to know how the drying process is progressing the board is removed from the kiln, weighed, and then placed back in the kiln. From this weight subtract the oven-dry weight, which shows how much water still remains in the board. Divide this weight by the oven-dry

weight, and the percentage of water is obtained. The following example illustrates how to determine moisture per cent by the use of a sample board:

Test piece shows 50 per cent moisture.
Add 100 to 50 = 150 per cent, which is expressed 1.50
Original weight of sample board = 16.4 lbs.

$$\frac{16.4 \text{ lbs.}}{1.50} = 10.93 \text{ lbs. calculated oven-dry weight}$$

To find moisture per cent at any time during run:
Weight of Board Minus Oven-dry Weight × 100 = Moisture per cent
Calculated Oven-dry Weight:
Example: If it weighed 14.5 lbs.:

$$\frac{14.5 - 10.93}{10.93} = .32 \text{ or } 32 \text{ per cent}$$

Placing of Sample Board—

It is good practice to have one test board for each 8,000 or 10,000 board feet. Place them in the pile in spaces left for them, and on sticks, so that air can circulate around them.

Do not put them on top of the pile, sticking out at the ends, or near the bottom, as they will dry out faster than the average of the pile, and give an erroneous indication of dryness of the pile as a whole.

Take the remainder of the board or boards from which the sample boards were cut, and place in the pile, preferably in the same tiers as the sample boards. These can be removed from the kiln and sample cut from them to determine moisture distribution, or to test for casehardening during or at the end of the run.

Quite often it is advisable to ascertain if stock is evenly dried or casehardened. Uneven moisture content and casehardening are very objectionable in fabrication, and are the direct causes for many failures in wood, particularly in the finished product. For this reason the following method of ascertaining these is given from *Kiln Drying Practice*, mentioned above:

Moisture Distribution Tests

During the kiln-drying process, it is often desirable to know whether the lumber is surface-drying too rapidly, which is the fundamental reason for casehardening, checking, warping, etc. Also, at the end of the run the difference in per cent between the shell and the core is useful information to have, indicating whether the lumber should be steamed, and how long it should be left in dry storage.

Select an average board from the lumber in the kiln and cut out two sections, about 1 inch wide across the board, as shown in Illustration 6, and one section $^1/_4$ inch wide. The thin section (*a*) can be used to find the average moisture per cent as previously described. Section (*b*) should be cut as shown so that the shell and core can be weighed separately and dried in the oven. Moisture per cent of shell and core are determined separately, after the manner previously described.

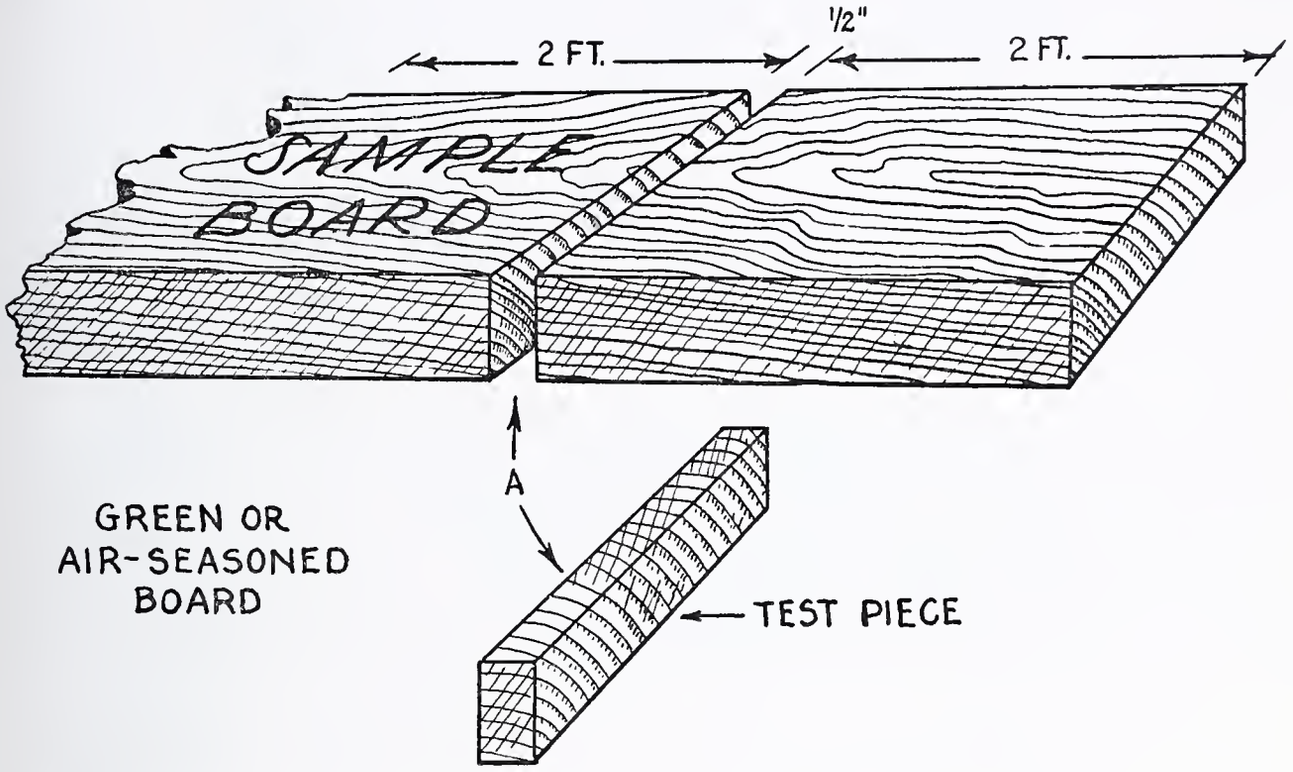
Casehardening Tests

The remaining section (*c*) is cut so as to remove part of the core (see Illustration 6). If the lumber is dry 5 to 11 per cent, and the prongs remain straight, as in No. 1 (Illustration 7), no stress is evident, but if they turn in, as in No. 3 (Illustration 7) casehardening is present.

Should the tests be made before the lumber is dry, it is quite likely that the prongs will turn out, as in No. 2. If it is nearly dry it may show casehardening stress, as in No. 3, and if it has been steamed a little too much at the end to remove the casehardening, the prongs are likely to turn out, as in No. 4.

Shrinkage Tests

Occasions arise when it is necessary to determine how much the lumber will shrink. Sometimes this method is used instead of moisture content determinations, in order to see if the stock has completed all its shrinking.

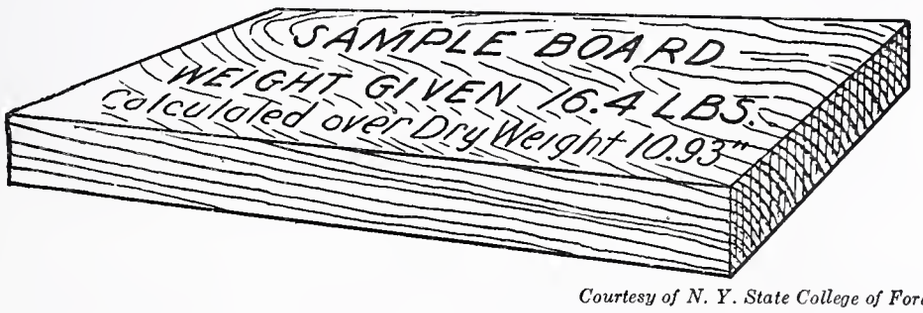


Courtesy of N. Y. State College of Forestry

Illustration 4—Method of cutting test piece for determining moisture content. Note that the test piece is cut from the board next to the sample board.

Cut off a test piece as (*a*) in Illustration 4. Draw a line and measure the distance across it. A special steel rule divided into inches and hundredths of inches is to be preferred for this work.

Mark the width on the pieces, dry in an oven to constant weight, and remeasure. The difference in the two measurements will be the amount of shrinkage.



Courtesy of N. Y. State College of Forestry

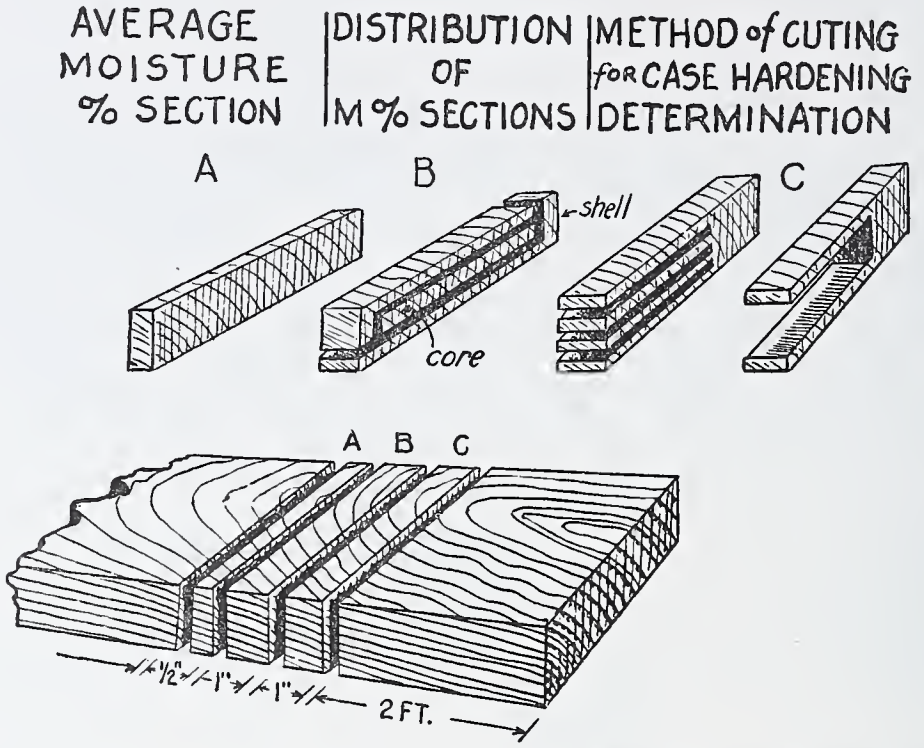
Illustration 5—Method of preparing sample board.

To express this in per cent, divide the amount of shrinkage by the original size, and multiply by 100.

This method of determining whether the lumber is dry is too unreliable to make much use of, as any casehardening tends to throw off the final results.

Mechanical Methods for Determining Moisture Content

Recently there have been developed mechanical methods of determining moisture content in wood. For many years electrical methods have been studied with the idea of

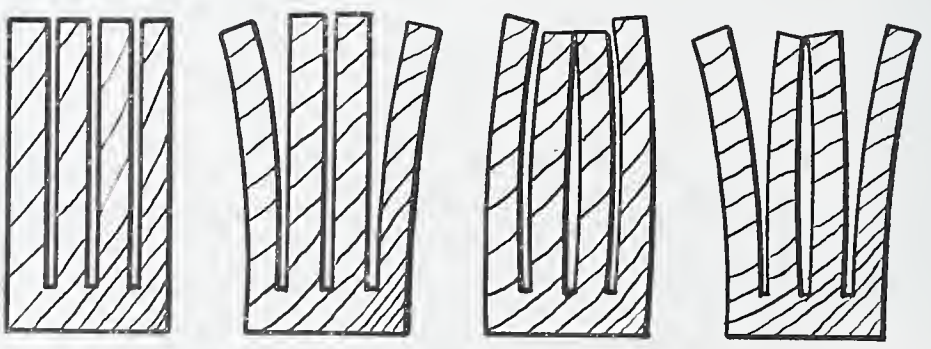


Courtesy of N. Y. State College of Forestry

Illustration 6—Test sections for determining moisture variations.

developing a process in which the electrical resistance of the moisture in wood could be used as a basis for determining the moisture content.

Several years ago an electrical device was developed by which moisture content determinations could be made instantly and accurately. Lumber manufacturers' associa-



No stress. Dry surface, wet core. Casehardening. Reversed stress.

Courtesy of N. Y. State College of Forestry

Illustration 7—Test sections showing typical stress sections.

tions and lumber users, alike, have welcomed this moisture meter, because it makes it possible to buy and sell lumber on a definite basis, and to eliminate claims and dissatisfaction.

TAG-Heppenstall Moisture Meter. (See Plate XVI.)

The device, known as the TAG-Heppenstall Moisture Meter (made by C. J. Tagliabue Mfg. Co., Brooklyn, N. Y.) was originally developed for use on West Coast softwoods, but investigation and actual use have demonstrated that it is not limited to those species.

The meter measures the electrical conductivity of the wood across two contact needles, and the findings of numerous investigators agree that electrical conductivity accurately measures moisture content, regardless of the species, except for a few rare exceptions.

The moisture meter consists of a case to which a testing handle is connected by 10 feet of flexible cable. The testing handle is fitted with double needle contacts for penetrating the wood, and a small electric lamp is used when sorting out wet stock. On the panel of the instrument are the milliameter, the control switches, and the selector switch, which is graduated from 7 to 24 per cent moisture. Dry batteries contained in the case are used for the operation of the instrument.

To measure the moisture content, it is only necessary to drive the needle points into the board to be tested, and then to turn the selector switch until the milliameter pointer is vertical. The selector switch will then indicate the moisture content.

To sort out wet stock rapidly (wet stock being that above a certain moisture content), a slightly different procedure is employed. If, for example, stock with a higher moisture content than 10 per cent is to be sorted out, the selector switch is set at 10 per cent. The needles are driven into each board and whenever the moisture content is *above* 10 per cent, a green lamp in the handle lights.

Fairbanks Moisture-Percentage Scales for Dry Kilns. (See Plate XVI.)

Another device for determining the moisture content of a kiln charge has been developed by T. E. Heppenstall and is being manufactured and distributed by Fairbanks, Morse & Co. of Chicago, Illinois. It is an electrical device that indicates and records the moisture content of lumber as it dries in the kiln, and is quite simple in its operation. Moisture content is determined by the weighing process.

A weighing scale is located on the roof of the dry-kiln and a rod extends down into the kiln. One or more representative boards are suspended from this rod by means of hooks.

The representative boards which are to be used to control the dry-kiln have their moisture contents determined by the regular method of cutting off small sections, weighing, drying, and reweighing. The representative board or boards are then placed on the scale hooks in the dry-kiln and the scale is adjusted to the determined moisture content by means of an adjusting nut.

The scale transmits its reading electrically to any convenient point, such as an office or control room.

The kiln operator in his office has a meter before him and can tell at a glance the actual condition of the lumber in any of the dry-kilns. The meter indicates the moisture content in percentage of oven-dry weight without the necessity of making a calculation. The condition of the lumber can be watched or recorded every minute or hour of the day if necessary, without any further attention by the operator. Any number of kilns can be thus equipped, but only one meter is required at the office. This meter can be connected to any dry-kiln simply by inserting a plug in a small switchboard which is connected with the scale of each kiln.

One of the meters used is an indicating type which can be connected to any kiln and the condition of the lumber noted instantly. The actual moisture content in per cent is indicated.

The other meter used is a recording type with a seven-day chart. It can be connected to any kiln but is generally used on a special test run and is left connected to the one kiln during the entire schedule. The results made by the indicating instrument may be plotted graphically on paper with the temperature and relative humidity, and the conditions of drying can be analyzed.

Moisture Content Indicator for Wood ("Blinker"). (See Plate XVI.)

Two forms of "Blinker" have been developed by the U. S. Forest Products Laboratory, Madison, Wis., and "announced in order that everyone interested may make use of the idea."

One form is known as a "lumber sorter" and another is used to measure the amount of moisture content of wood. The "Sorter" will indicate whether a piece of wood being tested is wetter or drier than specified in the order. This instrument embraces two neon tubes excited by a battery through condensers. When the operator is about to inspect a shipment of lumber or timbers, a standard condenser representing the specified moisture content is inserted in one circuit. When a switch is closed, one neon tube flashes at regular intervals as determined by the resistor and condenser used.

The wires of the other circuit are connected to points on the face of a hammer. When the hammer points are driven into the board being tested the other neon tube flashes at intervals determined by the amount of moisture in the board. If the flashes of the second tube are more frequent than those of the first it indicates that the board is wetter than called for by the specifications. Similarly, if the second tube flashes less frequently than the first the board is drier than specified.

The other form of "Blinker" used to measure the amount of moisture content of wood is very similar to the sorter, except that several graduated condensers are used to permit the inspector to determine the per cent of moisture in the piece tested. By varying the number or capacity of condensers in the circuit the test lamp or tube is made to flash at the same intervals as the first tube. The per cent of moisture content is read direct from the condenser or switch which brought about the equality of flash intervals.

Foxboro Automatic Kilnboy. (See Plate XVI.)

The Foxboro Automatic Kilnboy (made by The Foxboro Company, Foxboro, Mass.) is an automatic scale that weighs the sample in the kiln as it dries, and records this weight in terms of moisture content outside of the kiln. At the same time it automatically controls the drying schedule in accordance with the weight of the sample.

The entire drying is controlled by a sample board chosen and prepared in the usual way, which is placed on one end of the scale beam as if it were to be weighed. After the scale is adjusted, the entire operation becomes automatic. The changing moisture content of the sample steps up the schedule just as fast as the condition of the lumber allows.

The Automatic Kilnboy consists of three instruments together with the necessary auxiliary equipment: (1) Kilnboy Scale; (2) Humidity Recorder-controller fitted with Pneumatic Set Works; (3) Moisture content Gauge.

The Kilnboy Scale is a pneumatic scale the operation of which is similar to an adjustable air pressure reducing valve. It is placed in the air line between the air supply and the

Pneumatic Set Works. The weight of the moisture in the sample regulates the air pressure; the more moisture present the higher the pressure. As the sample loses moisture the scale automatically reduces the air pressure.

The Moisture content Gauge records this loss of pressure in terms of moisture content.

The Pneumatic Set Works is a cam-setting device inside the Humidity Recorder-controller Case. It is operated by a clock-spring mechanism and controlled by the air pressure from the Kilnboy Scale. As the air pressure is reduced by the loss of moisture in the sample the Pneumatic Set Works automatically resets the drying schedule cams, which in turn reset the control points on the Humidity Recorder-controller.

The Humidity Recorder-controller controls and records the wet and dry bulb temperatures in the kiln by automatically opening and closing the heating and spray valves. It controls these temperatures in accordance with the schedules set by loss of weight in the sample.

For example: place a sample which has already been determined to have 40 per cent moisture on the Kilnboy Scale. Then adjust the scale until the Indicating Gauge reads 40 per cent. Also adjust the Set Works to read 40 per cent, and the control points on the Humidity Recorder-controller will be set automatically at 140 degrees (dry bulb) and 130 degrees (wet bulb). Forty per cent moisture content is equivalent to some definite pressure in the Kilnboy system. When the moisture content of the sample has dropped to 30 per cent the Kilnboy Scale has reduced this pressure. This drop in pressure has changed the position of the schedule cams in the Set Works. The cams in turn set the control points at 145 degrees (dry bulb) and 133 degrees (wet bulb). This operation continues automatically until the kiln load is dry.

The operation of the device is a simple matter. When stacking a kiln truck a board, or boards, is left out of the middle of the stack in the usual manner and the sample board is substituted in its place. This will insure the same rate of drying for the sample as for the rest of the lumber. The Kilnboy is then clamped on to the side of the pile and the kiln truck is rolled into the kiln. The flexible air hose on the Kilnboy is attached to air risers in the kiln by quickly detachable couplings, and the air is turned on. The Scale Pan adjusting nut is then turned backward or forward until the Indicating Gauge on the Kilnboy Scale shows the moisture content of the sample corresponding with the original test. The Set Works are then set to the same moisture content and the remainder of the drying process is automatic.

Nomenclature of Species

According to the *Check List of the Forest Trees of the United States, Their Names and Ranges*, there are some 1,177 different kinds of North American forest trees, consisting of many species, varieties, and hybrids.

Botanists are responsible for the intensive research which has been conducted with regard to more extensive knowledge and information on the separation and identification of our timber trees. Botanical differences in wood structure, leaf variations, and other characteristics which more clearly define and separate varieties within a species are being constantly discovered.

Of the 1,177 different trees, there are 182 which are of special interest. The lumberman includes in his category of really important trees some 60 species. It is quite obvious that

the number of commercially important trees is not constant but depends upon the trend of commercial needs.

Common Names of Trees

Nomenclature of a given species varies regionally and sectionally. A widely distributed species may carry from 10 to 25 or more different names in various parts of its range. This condition has led to many inconsistencies and untold confusion in the trade. In many cases misapplied common names are given to certain species. For example, Douglas fir is not a true fir but belongs to an entirely different species. Lack of botanical knowledge has led to this practice.

Common Names and Trade Names

Unfortunately inconsistencies still exist, not alone in the names of species of trees but also in the names given to the lumber cut from these trees.

Red gum is the common name adopted for *Liquidambar styraciflua*. It applies not only to the tree but also to the lumber produced. The trade refers to the lumber as red gum, satin walnut, gumwood, hazelwood. The Forest Service says:

> Unless the consumer is able accurately to distinguish the lumber of the gum from that of the walnut, hazelwood, etc., serious confusion is likely to arise.

It is in many instances impractical to apply standard names of all timber trees to their lumber or wood products. For example, true white oak is an individual species. Today, due to the limited supply of lumber cut from this tree, the lumber of a number of other oaks of the white oak group is included and distributed under the general term "white oak lumber." The qualities and properties of lumber cut from this group is perhaps inferior to that of true white oak. Quoting further from the Forest Service:

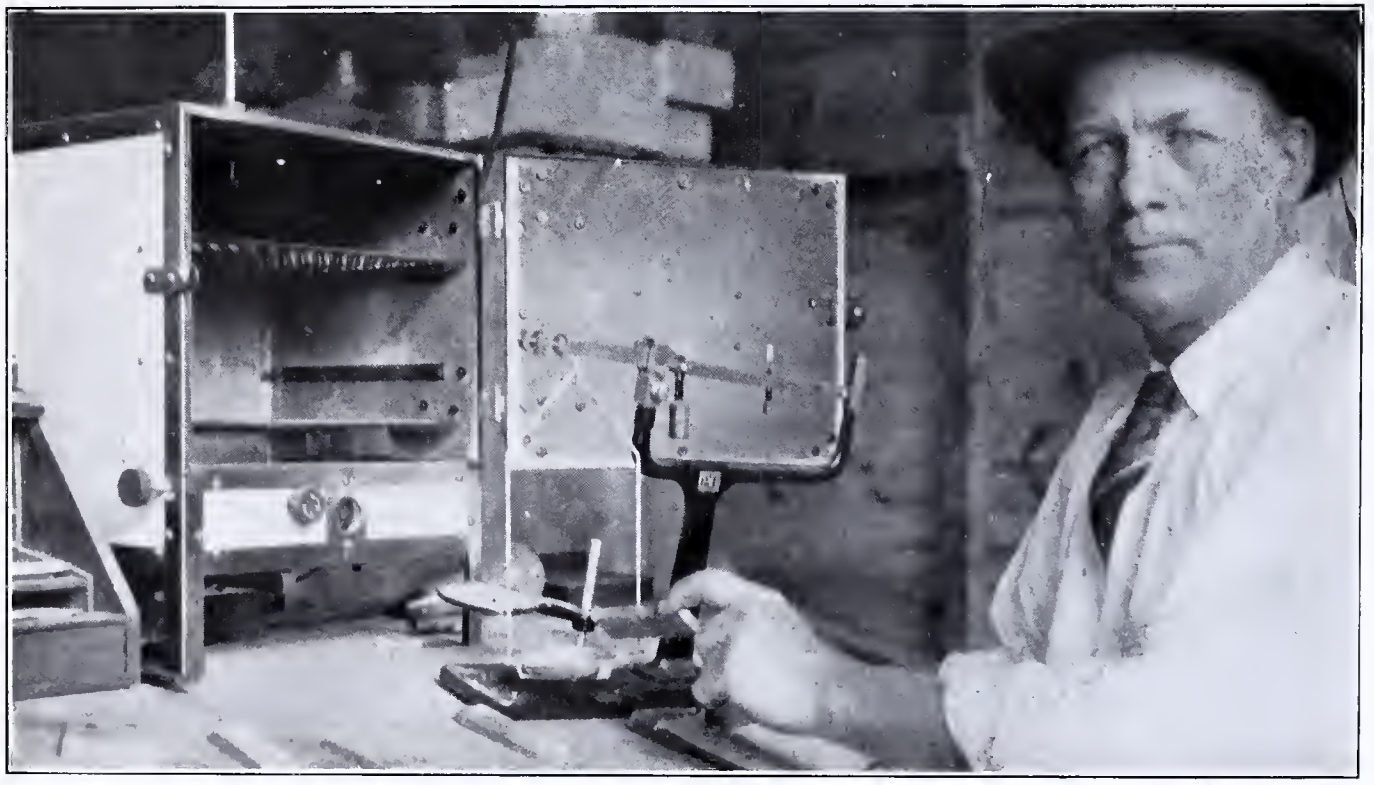
> There comes a time, therefore, in the commercial history of our timber species when the tree and its wood cannot continue to be known by the common name. This seems especially true when the attempt is made to disguise a mixture of inferior woods under a name that originally applied only to one set of high grade lumber. The consumer of lumber, not always able to accurately distinguish woods of similar appearance, has the right to purchase material that is either true to name or, if necessity compels mixing several different species under one trade name, of a commonly acknowledged commerical quality.

The misnaming of commercially important forest trees or their woods for trade purposes is extremely unfortunate, and in the past has led to many misunderstandings and litigations between consumers and producers.

Scientific Names

The botanist has classified trees scientifically, based upon certain characteristics which distinctly separate one species from another. These species have been separated into groups with family, genus, and species names that individualize them. The value of the technical or scientific name is, therefore, obvious.

The question of proper nomenclature of wood is of sufficient importance to consumers of lumber and wood products to make the following extract valuable. It is taken from the *Check List of Forest Trees of the United States,* and refers to the selection of standard names for trees and wood by the Forest Service. It is hoped that this will assist the consumer in clearly understanding trade names, common names. etc., as applied to the many commercial species now in use.



Courtesy of The National Committee on Wood Utilization

Plate XV—Drying oven and weighing scales used in determining moisture content of sample test piece.

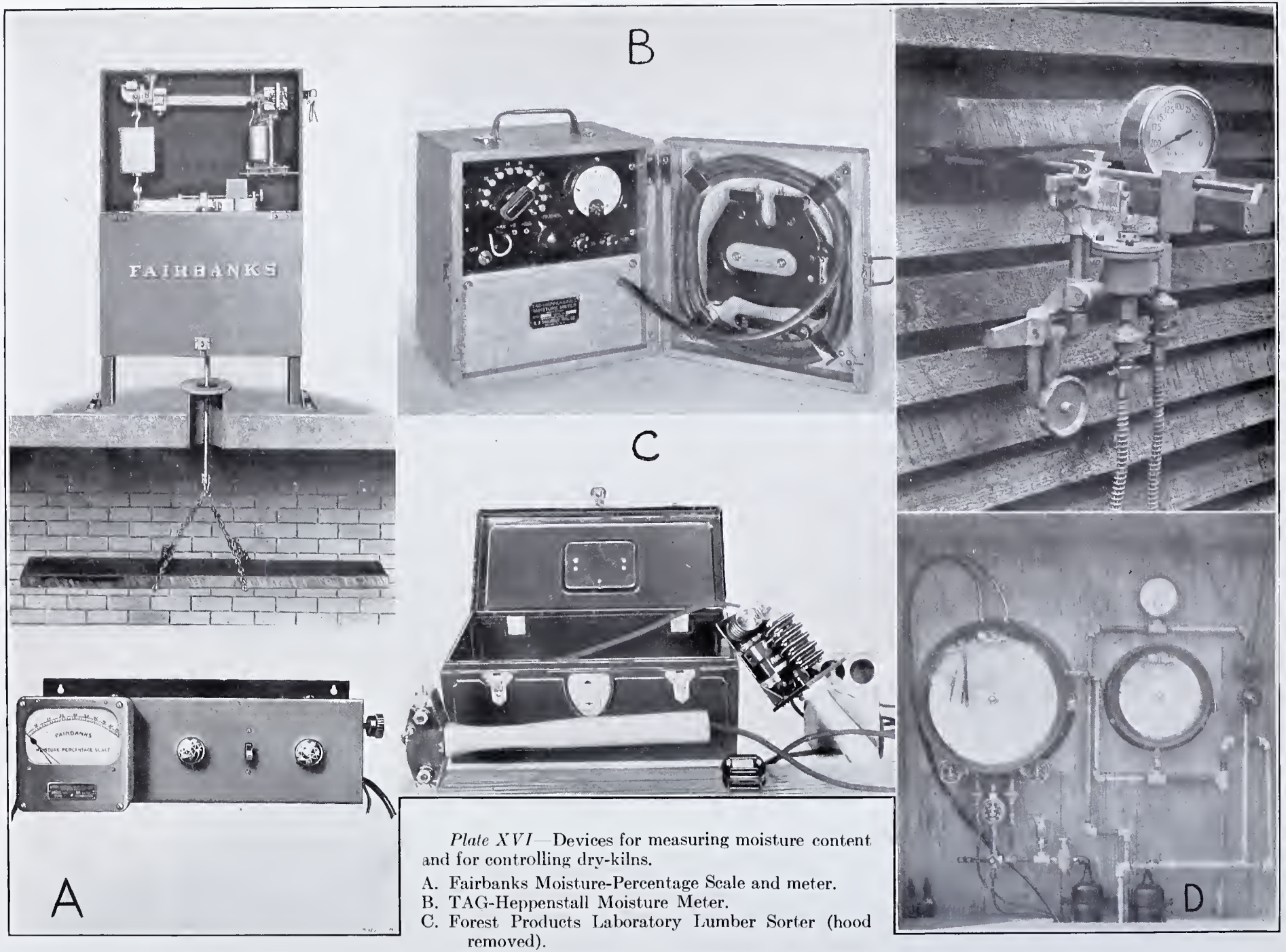


Plate XVI—Devices for measuring moisture content and for controlling dry-kilns.

A. Fairbanks Moisture-Percentage Scale and meter.
B. TAG-Heppenstall Moisture Meter.
C. Forest Products Laboratory Lumber Sorter (hood removed).
D. Foxboro Automatic Kilnboy Scale and Instruments.

FOREST SERVICE POLICY IN SELECTING STANDARD NAMES FOR TREES AND WOODS

In the interest of good trade practice and of protecting the consumer from obtaining inferior woods under the guise of misleading names, it is important that, so far as practicable, different trees and woods bear distinctive common names, that the names be uniformly used, and that concerted efforts be made to prevent adding to the present confusion through putting into circulation further misleading or ill-chosen names. In selecting standard common names of trees and woods for its own use, as well as for the purpose of furnishing helpful guidance to the interested public, the United States Forest Service has used the following principles:

1. The names of different trees and woods should be clear-cut and distinctive. They should not be ambiguous, confusing, or misleading.

2. So far as possible, a tree and the lumber cut from it should be called by the same name.

3. Attempts to standardize common names are met at the outset by pre-existing common names for most trees and woods—names that are hard to change and that must be given much weight. Preference should be given to the most widely used common name, provided it is not misleading. Artificially coined names should be adopted only as a last resort. This principle applies not only to native but to foreign woods. Aboriginal or native names like mahogany and teak should, when practicable, be used for imported woods instead of artificial or borrowed names.

4. Common names of trees and woods should, so far as possible, follow the major botanical groupings of trees. These groupings are based on inherent, recognizant resemblances; they constitute a logical, coherent, and universally recognized order and system. To base common names on superficial, often fluctuating resemblances between botanically unrelated groups, can only lead to confusion.

There are limits, however, beyond which common names can not follow botanical grouping. The botanical distinction of species may be based on characteristics too minute or inconspicuous to be easily recognized as the basis for distinct common names, as in the numerous species and varieties of basswood. Or an improper common name may have become too firmly entrenched in usage to be upset, as, for instance, the name cedar applied to *Juniperus, Chamæcyparis, Thuja,* and other genera.

5. When botanical differences among species and varieties of genus are too slight to serve as a basis for distinctive common names, a group common name should be applied. Examples are found in the basswoods, willows, hickories, oaks, etc.

Within certain genera there are groups of species having common characteristics distinct enough to differentiate them as whole groups from other groups within the same genus. Examples are the red and white oak groups, the black ash groups, and the white and yellow pine groups. These group distinctions should be preserved in the names used for the individual members of each group, so far as possible.

It is natural and legitimate that group common names should be more extensively used for lumber than for the corresponding trees, because the trees with their bark, foliage, flowers, and other characteristics are often more readily distinguished than is the lumber cut from them.

6. Ordinarily a distinct generic common name should be used for each member of a botanical genus, as spruce (*Picea*), pine (*Pinus*), oak (*Quercus*), elm (*Ulmus*), etc., unless (*a*) firmly established usage of the same common name for two or more genera (such as the name cedar for *Juniperus, Thuja, Chamæcyparis*), or of two or more generic common names for different members of the same genus (as butternut and walnut for members of the genus *Juglans*), prevents the adoption of the principle but does not lead to deception; or, unless, (*b*) two or more genera are so closely related botanically and their woods are so nearly identical in structures, properties, appearance, value, and usefulness as to be to all intents and purposes the same. This latter exception rarely applies to native woods, but conceivably might apply to certain closely related woods of tropical genera, if they are not readily distinguished in practice, and if no deception results from the use of a group generic

name. This principle is simply an extension of the principle of the group common name, as used in related species and varieties, to the larger groups known as genera. It is recognized that generic classification is not always fixed and unalterable, separate genera having sometimes been combined into one genus and single genera having sometimes been split up into two or more genera. When practicable, however, it would be preferable to follow the principle of a distinct name for each genus.

7. The common name of one species, group of species, or genus should not be used for that of another species, group, or genus in such a way as to be misleading, nor should it be used otherwise than as provided in paragraphs 5 and 6 above. Even a close superficial resemblance between woods widely separated botanically is no warrant for violating the principle of adhering to botanical groupings. The use of modifying terms, such as the state, region, or country in which the wood grows, or of some word descriptive of the wood itself, does not alone atone for borrowing a name, nor does it safeguard the consumer against confusion or even deception. The tendency is for artificially borrowed names (as distinguished from those borrowed through popular ignorance) to be used to create a market for unknown and very often inferior woods. The use of borrowed names must be guarded against more and more carefully as the importation of new and unknown woods increases; otherwise there will be endless deception. An example of such misleading practice is the name "swamp walnut" which has been applied to furniture made of willow lumber. It seems fair for each wood to stand on its own merits and to make its way under its own colors.

In the chapters devoted to information on "Species" will be found nomenclature based upon Forest Service separation, and American Lumber Standards.

It will be noticed that usually with the name of the tree from which the lumber is cut is listed the present accepted standard name. In the discussion there are listed species which produce the bulk of lumber cut from the tree or an associated group of trees. Especial effort has been made to include many, if not all, of the various names of the species discussed.

American Lumber Standards have adopted standard names for lumber, particularly softwood, cut from the various species.

Progress is constantly being made with regard to the nomenclature of species. Regional associations have obtained valuable information regarding trade names of species, and lumber cut from such species, and are at any time glad to coöperate with consumers in disseminating information of this nature.

Standard Names of Lumber and of the Corresponding Trees Recommended by the Forest Service

The following list taken from *Check List of Forest Trees of the United States,* is offered as a means of acquainting lumber users with the standard names employed by the Forest Service for lumber and for the trees from which it is cut. In large measure the names applied to the lumber correspond with those used for the trees. The list will also help to clear up a great deal of confusion among lumber consumers resulting from use in the trade of needlessly multiplied and often misleading names:

Names of Lumber	Common Names of Trees	Technical Names of Trees
Northern White Pine:	Northern white pine	Pinus strobus
Also sold as northern pine; Canadian white pine; soft white pine; white pine; Wisconsin white pine; soft cork white pine; Minnesota white pine; soft Minnesota white pine; eastern white pine		

Names of Lumber	Common Names of Trees	Technical Names of Trees
Western White Pine: Also sold as Idaho white pine; soft Idaho white pine	Western white pine	Pinus monticolo
Sugar Pine: Also sold as California sugar pine	Sugar pine	Pinus lambertiana
Norway Pine: Also sold as red pine	Norway pine	Pinus resinosa
Western Yellow Pine: Also sold as Pondosa pine; western white pine; Oregon white pine; Oregon pine; California white pine; western pine; Arizona soft pine	Western yellow pine Jeffrey pine Usually marketed with western yellow pine (P. ponderosa), which it closely resembles	Pinus ponderosa Pinus jeffreyi
Lodgepole Pine: Also sold as tamarack	Lodgepole pine	Pinus contorta
Jack Pine: Also sometimes sold as Hudson Bay pine	Jack pine	Pinus banksiana
Southern Yellow Pine:		
Loblolly Pine: Also sold as North Carolina pine; Virginia pine; Arkansas soft pine; southern pine; southern yellow pine	Loblolly pine	Pinus tæda
Shortleaf Pine: Also sold as Arkansas soft pine; North Carolina pine; shortleaved yellow pine; southern yellow pine; Arkansas shortleaf pine; southern pine	Shortleaf pine	Pinus echinata
Longleaf Pine: Also sold as Florida longleaf yellow pine; southern yellow pine; Georgia yellow pine; yellow pine; longleaved yellow pine; southern pine	Longleaf pine	Pinus palustris
Pitch Pine: Also sold as southern pine and southern yellow pine	Pitch pine	Pinus rigida
Pond Pine: Also sold as southern pine and southern yellow pine	Pond pine	Pinus rigida serotina
Slash Pine: Also sold as southern pine and southern yellow pine	Slash pine	Pinus caribæa

Names of Lumber	Common Names of Trees	Technical Names of Trees
Virginia Pine: Also sold as North Carolina pine and spruce pine	Virginia pine	Pinus virginiana
Spruce Pine: Also sold as southern pine, southern yellow pine, and southern white pine	Spruce pine	Pinus glabra
Tamarack:	Tamarack	Larix laricina
Western Larch: Also sold as larch and Montana larch	Western larch	Larix occidentalis
Eastern Spruce:	Red spruce. Also sold as West Virginia spruce; red spruce; Adirondack spruce; Canadian spruce	Picea rubra
	White spruce. Also sold as white spruce; Canadian spruce; Adirondack spruce	Picea glauca
	Black spruce. Also sold as black spruce	Picea mariana
Sitka Spruce: Also sold as yellow spruce; western Sitka spruce; silver spruce; Sequoia silver spruce; West Coast spruce	Sitka spruce	Picea sitchensis
Engelmann Spruce:	Engelmann spruce	Picea engelmannii
Eastern Hemlock: Also sold as West Virginia hemlock; hemlock; Wisconsin white hemlock; Pennsylvania hemlock; Pennsylvania white hemlock; Huron pine	Eastern hemlock	Tsuga canadensis
West Coast Hemlock: Also sold as Pacific hemlock; Pacific Coast hemlock; Pacific (Western) hemlock; hemlock	Western hemlock	Tsuga heterophylla
Mountain Hemlock:	Mountain hemlock	Tsuga mertensiana
Douglas Fir: Also sold as Douglas yellow fir; Oregon fir; fir; red fir; Pacific Coast Douglas fir; Montana fir; national yellow fir; yellow fir; Oregon pine; golden rod Douglas fir; yellow Douglas fir; "Sanitian" quality fir	Douglas fir	Pseudotsuga taxifolia

Names of Lumber	Common Names of Trees	Technical Names of Trees
Alpine Fir:	Alpine fir Corkbark fir The wood of these two firs is probably not milled separately and need not be because of their close similarity in appearance and quality. Both should be marketed under one trade name, Alpine fir	Abies lasiocarpa Abies arizonica
Eastern Fir: Also sold as balsam and balsam fir. The trade names eastern fir, balsam, and balsam fir may possibly include wood of the southern balsam fir (Abies frasieri), the wood of the two botanically distinct species being very similar in quality	Balsam fir	Abies balsamea
Noble Fir: Formerly and still sold as larch	Noble fir	Abies nobilis
California Red Fir: Also sold as golden fir	California red fir	Abies magnifica
Silver Fir Also sold as white fir and larch	Silver fir	Abies amabilis
White Fir: Also sold as balsam fir	White fir Lowland white fir	Abies concolor Abies grandis
Southern Cypress: Also sold as red cypress; yellow cypress; Louisiana red cypress; Gulf red cypress; tidewater red cypress; Gulf Coast red cypress; white cypress; black cypress; cypress; Gulf cypress	Southern cypress	Taxodium distichum
Redwood:	Redwood	Sequoia sempervirens
Incense Cedar: Also sold as cedar; roughbark cedar	Incense cedar	Libocedrus decurrens
Northern White Cedar: Also sold as white cedar; Michigan white cedar; New Brunswick cedar	Northern white cedar	Thuja occidentalis
Southern White Cedar: Also sold as white cedar ("juniper")	Southern white cedar	Chamæcyparis thyoides
Western Red Cedar: Also sold as cedar; red cedar pine; Washington red cedar	Western red cedar	Thuja plicata

Names of Lumber	Common Names of Trees	Technical Names of Trees
Alaska Cedar: Also sold as Alaska yellow cedar	Alaska cedar	Chamæcyparis nootkatensis
Port Orford Cedar: Also sold as Port Orford (white) cedar	Port Orford cedar	Chamæcyparis lawsoniana
Eastern Red Cedar: Also sold as Tennessee red cedar	Eastern red cedar Southern red cedar	Juniperus virginiana Juniperus lucayana
Butternut:	Butternut	Juglans cinerea
Walnut: Also sold as American walnut	Black walnut	Juglans nigra
Pecan:	Pecan	Hicoria pecan
Hickory:	Shagbark hickory Bigleaf shagbark hickory Pignut hickory Bitternut hickory Mockernut hickory	Hicoria ovata Hicoria laciniosa Hicoria glabra Hicoria cordiformis Hicoria alba
Willow:	Black willow	Salix nigra
Cottonwood:	Eastern cottonwood Black cottonwood	Populus deltoides Populus trichocarpa
Birch:	Yellow birch Heartwood of yellow birch sold as red birch Sweet birch River birch Paper birch	Betula lutea Betula lenta Betula nigra Betula papyrifera
Beech:	Beech	Fagus grandifolia (= F. atropunicea)
Chestnut:	Chestnut	Castanea dentata
White oak:	White oak Also sold as West Virginia soft white oak; forked-leaf white oak Post oak Swamp chestnut oak Overcup oak Swamp white oak Bur oak Chinquapin oak Chestnut oak	Quercus alba Quercus stellata Quercus prinus (= Q. michauxii) Quercus lyrata Quercus bicolor Quercus macrocarpa Quercus muehlenbergii Quercus montana (= Q. prinus)
Red Oak:	Red oak Also sold as West Virginia soft red oak	Quercus borealis maxima (= Q. rubra) (Auth's. not L.)

Names of Lumber	Common Names of Trees	Technical Names of Trees
Red Oak:—Continued	Black oak	Quercus velutina
	Southern red oak	Quercus rubra (= Q. digitata)
	Swamp red oak	Quercus rubra papodæfolia
	Water oak	Quercus nigra
	Texas red oak	Quercus texana
	Willow oak	Quercus phellos
	Pin oak	Quercus palustris
Soft Elm:	American elm	Ulmus americana
Gray Elm:	Slippery elm	Ulmus fulva
Rock Elm:	Rock elm	Ulmus racemosa
Hackberry:	Hackberry	Celtis occidentalis
	Sugarberry	Celtis laevigata (= C. mississippiensis)
Magnolia:	Cucumber magnolia Also sometimes sold as cucumber and sometimes in mixture with yellow poplar	Magnolia acuminata
	Evergreen magnolia	Magnolia grandiflora
Yellow Poplar: Also sold as soft yellow poplar; poplar, and whitewood	Yellow poplar	Liriodendron tulipifera
Red Gum: Also sold as Delta red gum. The sapwood of red gum is usually sold as sap gum	Red gum	Liquidambar styraciflua
Sycamore:	Sycamore	Platanus occidentalis
Cherry:	Black cherry	Prunus serotina
Locust:	Black locust	Robinia pseudoacacia
Hard Maple: Also sold as maple; sapwood graded as "white maple"	Sugar maple	Acer saccharum
	Black maple	Acer nigrum
Soft Maple:	Red maple	Acer rubrum
	Silver maple	Acer saccharinum
Buckeye:	Yellow buckeye	Aesculus octandra
Basswood:	Basswood	Tilia glabra (T. americana)
	White basswood	Tilia heterophylla
Black Gum:	Black gum	Nyssa sylvatica
Tupelo:	Tupelo gum	Nyssa aquatica
Ash (Black): Also sold as brown ash and ash (black or brown)	Black ash	Fraxinus nigra

Names of Lumber	Common Names of Trees	Technical Names of Trees
Ash (White):		
	White ash	Fraxinus americana
	Blue ash	Fraxinus quadrangulata
	Red ash	Fraxinus pennsylvanica
	Green ash	Fraxinus pennsylvanica lanceolata
	Biltmore ash	Fraxinus biltmoreana
	Oregon ash	Fraxinus oregona
Mahogany: Also sold as Honduras mahogany; Mexican mahogany; San Domingan mahogany; Cuban mahogany; Costa Rican mahogany; and Guatemalan mahogany	Mahogany	Swietenia mahagoni

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LUMBER—ITS MANUFACTURE AND UTILIZATION

American Lumber Standards

The value of standardization and simplification to American industry needs little or no introduction.

The American lumber industry was no more guilty than other industries of having a multitude of sizes and other specifications covering the products with which it dealt. There was formerly little uniformity in rough or seasoned stock. This was probably due to the fact that mills simply cut lumber rough in any size or shape easiest for them, and shipped it to points of consumption. There it was surfaced, recut, or machined, as the case may be. Much lumber was used near the mills and local grading customs differed. These caused confusion when lumber was shipped to distant points.

Manufacturing methods at the mills gradually improved. With attempts to formulate grades, the variations in size argued the need for standardization in the industry. Years of study on the part of those directly or indirectly connected with the industry have at last developed for the consumers standards in both hardwood and softwood lumber which are of inestimable value.

Standardization of lumber, in brief, means the adoption of uniform sizes, grades, nomenclature of species, definitions of defects, etc.

American Lumber Standards undoubtedly had their beginning at the Convention of the American Lumber Congress in 1919. During the last week in May, 1922, the first general lumber conference was held, followed by other meetings, with Herbert Hoover, then Secretary of Commerce, directing the work. The purpose in mind for this standardization was to eliminate unnecessary and often wasteful sizes, and to formulate basic rules for the commercial grading of lumber. It also sought to guarantee to the consumer lumber which had been standardized regardless of the species, the methods of manufacture, and the producing region, with particular reference to its adaptability for the use intended.

The work has been carried on under the direction of the Central Committee on Lumber Standards composed of representatives of producers, distributors, and consumers. American Lumber Standards are the result of the united efforts of producers, distributors, and consumers of softwood lumber, in collaboration with the United States Department of Commerce and the Department of Agriculture. Association grading rules, based on the American Lumber standards should be used for specifications and transactions involving softwood lumber, by manufacturers and consumers of all commercial grades.

Interpretation of the Term "Lumber"

Lumber is essentially a rough product intended for subsequent manufacture or use in its "entirety." Lumber is defined in the dictionary as "Timber sawed into merchantable form, especially boards, from a tree (log)." Frequently, it more specifically refers to boards of small dimensions and size.

Many terms are used at present with regard to the sawed products produced from the log. In England, lumber is referred to as timber, while in this country timber generally means standing trees or heavy-dimension material produced from the log.

According to American Lumber Standards lumber is the product of the saw and planing mill, not further manufactured than by sawing, resawing, and passing lengthwise through a standard planing machine, or crosscut to length and matched.

Special attention is called to the classifications and definitions of types of softwood lumber as shown in American Lumber Standards.

Lumber Classifications

American Lumber Standards for softwood lumber have applied the following definitions in regard to the classifications of lumber based upon principal uses:

For the purposes of the simplification of sizes and grades, and of equalizing the grades of a similar name among species used for similar general purposes, lumber shall be classified by principal uses into (*a*) yard lumber; (*b*) structural material; (*c*) factory and shop lumber.

Use Classification

Lumber is the product of the saw and planing mill not further manufactured than by sawing, resawing, and passing lengthwise through a standard planing machine, crosscut to length, and matched. Lumber is classified as (*a*) yard lumber; (*b*) structural material; and (*c*) factory and shop lumber. Different grading rules may apply to each class of lumber.

Yard Lumber: Lumber that is less than 5 inches in thickness and is intended for general building purposes. The grading of yard lumber is based upon the use of the entire piece.

Structural Material: Lumber that is 5 inches or over in thickness and width. The grading of structural material is based upon the strength of the piece and the use of the entire piece.

Factory and Shop Lumber: Lumber intended to be cut up for use in further manufacture. It is graded on the basis of the percentage of the area which will produce a limited number of cuttings of a specified or a given minimum size and quality.

Size Classification

Yard Lumber

Strips: Yard lumber less than 2 inches thick and under 8 inches wide

Boards: Yard lumber less than 2 inches thick and 8 inches or over in width

Dimension: All yard lumber except boards, strips, and timbers; that is, yard lumber 2 inches and under 5 inches thick, and of any width

Planks: Yard lumber 2 inches and under 4 inches thick and 8 inches and over wide

Scantlings: Yard lumber 2 inches and under 6 inches thick and under 8 inches wide

Heavy Joists: Yard lumber 4 inches and under 6 inches thick and 8 inches or over wide

Structural Material

Timbers: Lumber 5 inches or larger in least dimensions

Manufacturing Classification

Manufactured lumber is classified as (*a*) rough, (*b*) surfaced, and (*c*) worked

Rough Lumber: Undressed, as it comes from the saw

Surfaced Lumber: Lumber that is dressed by running it through a planer. It may be surfaced on one side (S1S), two sides (S2S), one edge (S1E), two edges (S2E), or a combination of sides and edges (S1S1E), (S2S1E), (S1S2E), or (S4S)

Worked Lumber: Lumber which has been run through a matching machine, sticker, or molder. Worked lumber may be (*a*) matched, (*b*) ship-lapped, or (*c*) patterned

Matched Lumber: Lumber that is edge dressed and shaped to make a close tongued and grooved joint at the edges or ends when laid edge to edge or end to end
Ship-lapped Lumber: Lumber that is edge dressed to make a close rabbeted or lapped joint
Patterned Lumber: Worked lumber that is shaped to a patterned or molded form

Other terms frequently used in the trade to represent different forms of lumber are:

Cant: A log which has been slabbed on one or more sides
Flitch: A thick piece of lumber with wane on one or both edges
Board: A piece of sawed lumber 1 inch in thickness and varying in length and width
Square: A large timber obtained from slabbing a log on four sides
Barn Board: Lumber used in the construction of barns
Air-dried Boards: Lumber which is seasoned in the open air, as contrasted to kiln-dried lumber
Baseboards: A form of interior trim usually fastened to the walls of a room at the floor line
Casing: A form of interior trim used for "casing in" windows and doors
Clapboard: A board usually 4 to 6 inches or wider, used to cover the sides of a building. The boards generally are cut to taper to thin edge
Dog Board: The last board cut on the log carriage. The edges are generally punctured by the "dogs" on the head blocks
End-matched Board: Boards furnished with tongue and groove on the ends
Finish: The higher grades of yard lumber
Feather-edge Boards: Boards thin on one edge
Green Lumber: Lumber with a high percentage of moisture
Kiln-dried Lumber: Lumber which is artificially dried in kilns to various moisture contents
Merchantable Lumber: The entire cut of a mill, except mill culls
Mill Culls: The nonmerchantable part of the lumber cut from logs. This term also refers to the lowest grade of lumber produced
Plain-sawed Lumber: All lumber which is not quarter-sawed
Quarter-sawed Lumber: Lumber which is cut parallel to the wood rays. (See Illustration 3.)
Resawed Lumber: Lumber which is cut into two or more pieces on a resaw
Scantling: A small piece of timber (2 x 4, 2 x 2, etc.)
Scoots: Hardwood lumber below the grade of No. 3 Common, sometimes referred to as mill culls
Shiplap: A form of matching for lumber
Shorts: Lumber shorter than standard lengths, generally 6 feet or less
Siding: (*a*) Boards cut from the outer parts of lumber; the center is generally left in timber form
(*b*) Also refers to a type of machined and fabricated stock used for construction
Sheathing: Lumber used to cover exterior of buildings
Stepping: Lumber worked to a size and pattern suitable for stair treads
Wagon-box Boards: Lumber generally spoken of as box boards, of wide widths (13 inches and up), used for wagon bodies and boxes
Washboard: Ridged lumber produced by the saw or planer action

(See general list of Abbreviations and Glossary.)

The Manufacture of Lumber from the Log

Lumber is cut directly from the log in its green state as taken from the woods. Many improvements have taken place in the development and use of American sawmill machinery. Much lumber today is cut in modern and efficiently equipped mills.

Two predominating types of saws are used: band saws and circular saws. Some mills cut up to a million or more board feet per day. Many consumers prefer band-sawed lumber, perhaps because of the more smoothly sawed surfaces and greater precision in thickness, resulting in more highly refined stock. While it is true that the smaller circular mills in the past have not produced as high grade stock as the band mills, particularly in hardwoods, carefully manufactured lumber from either the band or circular saw is comparable

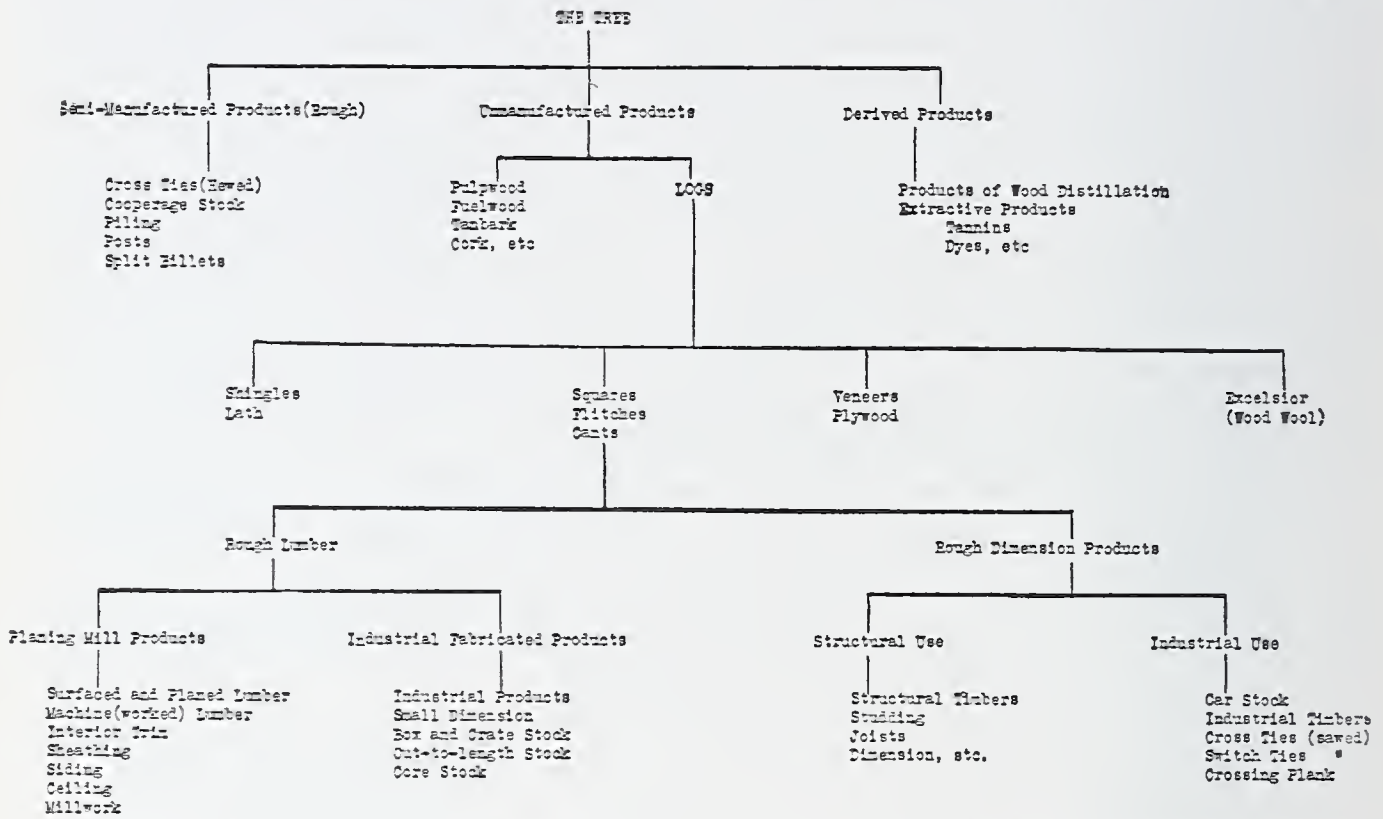


Illustration 8—Diagram indicating the development of wood products cut from the tree, as fabricated by the saw, planing mill, or other wood working plants. The utilization of waste is not included.

in value for any purpose. There is no striking difference between band-sawed and circular-sawed lumber, and it can be used for any purpose, providing it conforms to sizes and grades specified in grading rules for hardwood or softwood species.

In general, in manufacturing lumber, the log is placed upon a carriage in the sawmill, and sawed in such a manner as to produce the highest quality stock which can be obtained from the log. The better grades are produced from the outside of the log. The best logs will cut from 10 to 15 per cent of first and second grades (hardwoods), or the upper grades (selects) in softwoods will average around 20 per cent.

In Illustration 8 is shown a diagram illustrating the process by which lumber and wood products are converted from the tree. It treats specifically of usable raw material. Approximately only from 35 to 55 per cent of the entire tree is utilized, and only 45 per cent of seasoned rough lumber is obtained from the log. Woodworking wastes may run up as high as 30 to 40 per cent in the manufacture and use of rough seasoned lumber.

Lumber Measurements

In the trade, the primary unit of lumber measurement is the board foot, based upon a piece of wood one inch thick, 12 inches wide, and one foot long. This unit constitutes a square foot of wood, one inch thick.

Lumber in large quantities is usually measured on the basis of a thousand feet, and quoted at a unit price per 1,000 board feet. Lumber in small lots or by the piece is frequently quoted by retailers on a lineal foot price basis. In determining lineal foot price, board foot measurement is simply converted into lineal feet, and the unit price per 1,000 feet is used as a basis for determining lineal foot value.

In calculating the number of board feet in a board, simply multiply its thickness in *inches* by its width in *inches* and length in feet and divide by 12. Another method is to multiply the surface measure in *square feet* by the thickness in inches. For example: How many board feet in a board 2″ x 12″ x 16′? $\frac{2 \times 12 \times 16}{12} = 32$ board feet, or the board's surface measure consists of 16 square feet (12″ x 16′), and multiplying by its thickness—2″—the board contains 32 feet board measure.

It is interesting to note that doubling any one dimension of a piece of lumber doubles its volume, and by doubling two dimensions the volume is increased fourfold, while if three dimensions are doubled, an increase of eightfold results. For example:

A piece 12 x 12— 6 ft. long contains 12 board feet
A piece 2 x 12—12 ft. long contains 24 board feet (doubled)
A piece 2 x 24—12 ft. long contains 48 board feet (fourfold)
A piece 4 x 24—12 ft. long contains 96 board feet (eightfold)

Conversely, the opposite of this is:

A piece 4 x 12—12 ft. long contains 48 board feet
A piece 2 x 12—12 ft. long contains 24 board feet
A piece 1 x 12—12 ft. long contains 12 board feet
A piece 1 x 6—12 ft. long contains 6 board feet
A piece 1 x 6— 6 ft. long contains 3 board feet

Often in the trade the thickness of lumber is expressed in such terms as 4/4 (four-quarter), 5/4 (five-quarter), 6/4 (six-quarter), 8/4, etc., instead of 1″ (one inch), 1¼″ (inch and one-quarter), 1½″ (inch and one-half), 2″ (two-inch), respectively. This method of expressing lumber thickness simply means that the basis of measurement is in quarters of an inch instead of an inch.

Lumber Tally

In order to accurately measure lumber and to obtain its board feet content, a measuring device known as the tally stick has been perfected. Expert lumber graders and talliers display considerable dexterity in the use of the tally stick which is the result of long practice and experience.

Several different types of tally sticks have been developed, each designed for a different type of scaling. Some are designed to measure either the board feet contents or simply the width of a board. In other cases different tally sticks must be used to obtain these separate measurements.

In any case the length of the board must first be known. To obtain the board feet contents the tally stick is laid across the width of the board with the brass stop even with the left-hand edge of the board. For example, in a board 1″ x 4″ x 12′, follow the line of dots extending to the right of the 12′ mark on the tally stick. The dot number on the tally which coincides with the edge of the board indicates the board feet contents. In this case the edge of the board coincides with the 4′ dot mark, thus indicating that there are 12 board feet in the board.

Hardwoods are tallied on a board foot tally stick on which are placed marks indicating board feet contents of one inch stock for the various lengths (12′, 14′, 16′ on one side, and 8′, 10′, 18′ on the other side). It will be noted that one-half foot marks are indicated on the

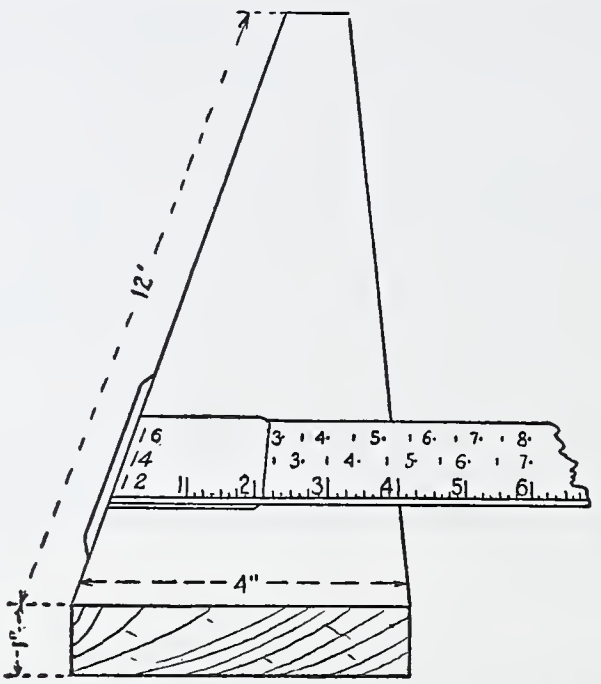
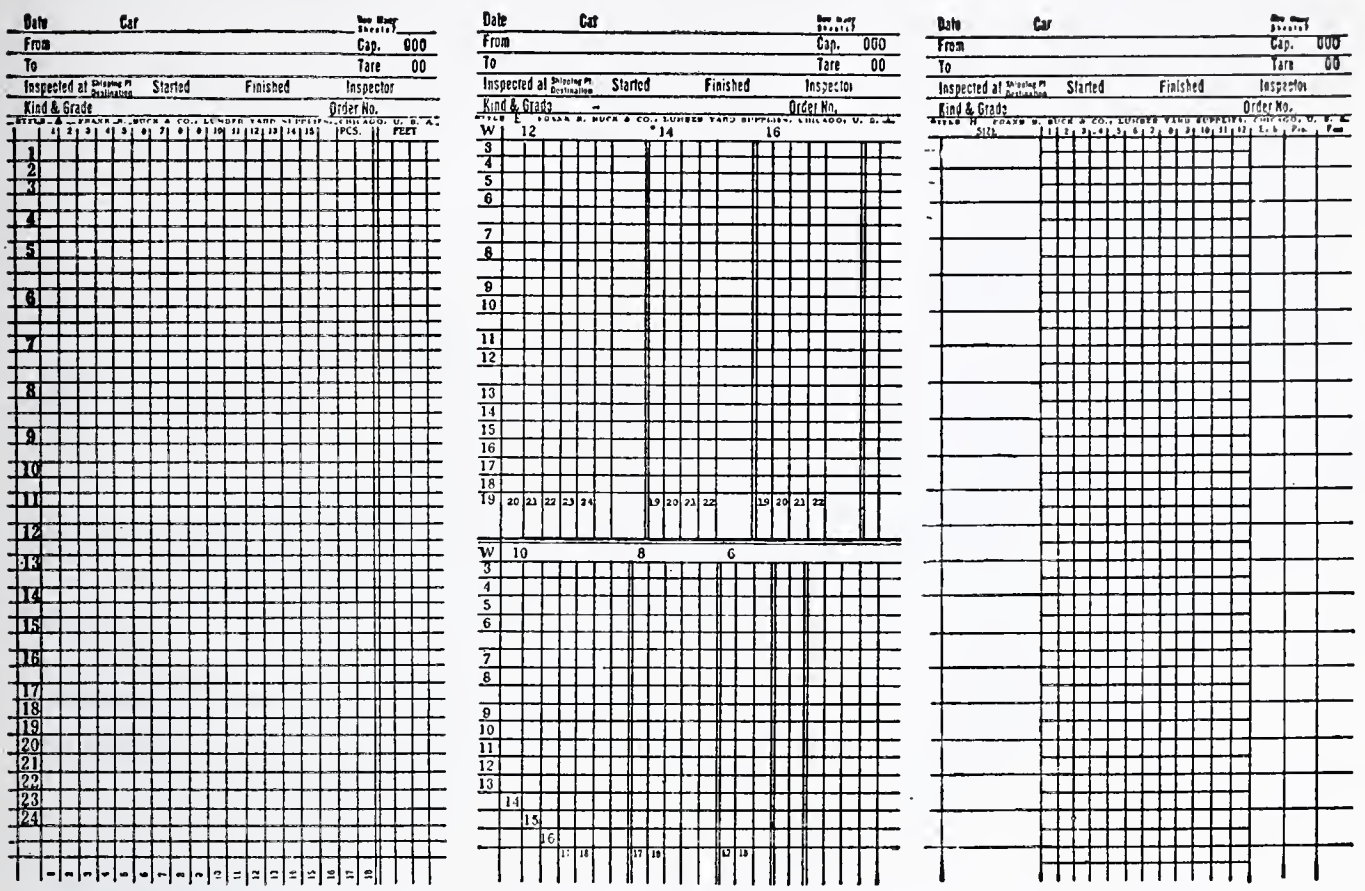


Illustration 9—A diagrammatic drawing illustrating tally stick method of measuring "even and odd width lumber." Note that the represented 1″ x 4″ x 12′ board contains 4 board feet inasmuch as the edge of the board coincides with the 4 foot dot. Marks between the numerical dots represent half-foot values. A 14-foot board of the same width would measure 5 board feet. ("Even half-foot marks shall be alternately counted as the next higher value and lower foot count; fractions below the one-half mark shall be dropped and fractions above the one-half foot mark shall be counted as the next higher foot.") A 16-foot board would therefore contain 5 board feet.The reverse side of the tally stick is used for measuring 8, 10, and 18-foot boards in exactly the same manner as described above. (See also Lumber Tally.) Lengths shorter than those shown on the tally stick (4′, 5′, 6′, 7′) can be obtained by taking *half* the value of 8′, 10′, 12′, and 18′ measurement values.

tally stick also. In measuring, if the board extends beyond the half-foot mark, it is measured as of the next highest figure; if exactly on the half-foot mark or less, it is counted back to the next lowest figure. (See Illustration 9.)



Courtesy Frank R. Buck Company

Illustration 10—Tally sheets commonly used for tallying lumber
A. Board feet tally sheet, used for tallying hardwoods.
B. Piece tally for tallying pieces, width and length of lumber.
C. Tally sheet often used for tallying dimension (size, pieces and board feet).

Softwood stock is generally cut in even width inches, while in hardwood stock random widths are produced. For this reason, softwoods are generally tallied on a thickness, width, and length tally, and the board feet content is obtained by computation afterwards.

Several types of tally are now in use. The most popular for general use in this country is the actual board foot measure tally. Illustration 10 shows a form commonly used in making this type of tally. Each board is measured to obtain its board feet content. On the tally card a dot is placed in one of the squares opposite the column on the left, each dot representing a board of a particular board feet content; nine dots and a cross indicate ten boards.

Tally is made on a basis of 4/4 stock. In 5/4, 6/4, etc., it is measured as if of 4/4, and after the completion of the tally the following adjustments are made:

5/4 stock: add ¼ of tally to original 4/4 tally
6/4 stock: add ½ of tally to original 4/4 tally
8/4 stock: multiply 4/4 tally by 2
10/4 stock: multiply 4/4 tally by 2½
12/4 stock: multiply 4/4 tally by 3
16/4 stock: multiply 4/4 tally by 4

In hardwoods, rough lumber 4/4 and less is tallied and measured as 4/4 inch stock.

In softwoods, machined and fabricated stock is measured as of the size of the rough stock from which it is produced.

Plain-sawed and Quarter-sawed Lumber

Logs are sawed in such a manner as to produce the highest quality and greatest quantity of lumber or wood products with the least waste. From experience, sawmill men have learned to judge approximately just what a log will produce. Hardwoods and softwoods are generally cut to grade.

Two distinct methods of sawing logs are employed: namely, plain-sawing and quarter-sawing. In Illustration 11 is depicted a log in which the two types of boards are shown just as cut from the log, and in their relative positions.

Quarter-sawed or Edge Grain Lumber

As a general rule certain species of wood are much desired for quarter-sawing, as a pronounced figure can be obtained which is highly prized in the trade.

Large logs are generally preferred, since considerable waste occurs in quartering. In true quartering this waste may run as high as 20 per cent of the board feet content of the log.

Probably the term "quarter-sawed" directly refers to the way in which the log was first cut into sections or quarters and then sawed into boards. There are many methods of sawing logs to obtain quarter-sawed stock, and the one chosen depends upon the purpose for which the product is to be used. The most important reason for quartering lumber is to show a figure. It will be noted that the figure developed is the result of cutting more or less parallel to the wood rays and thus exposing their flat surfaces on the board.

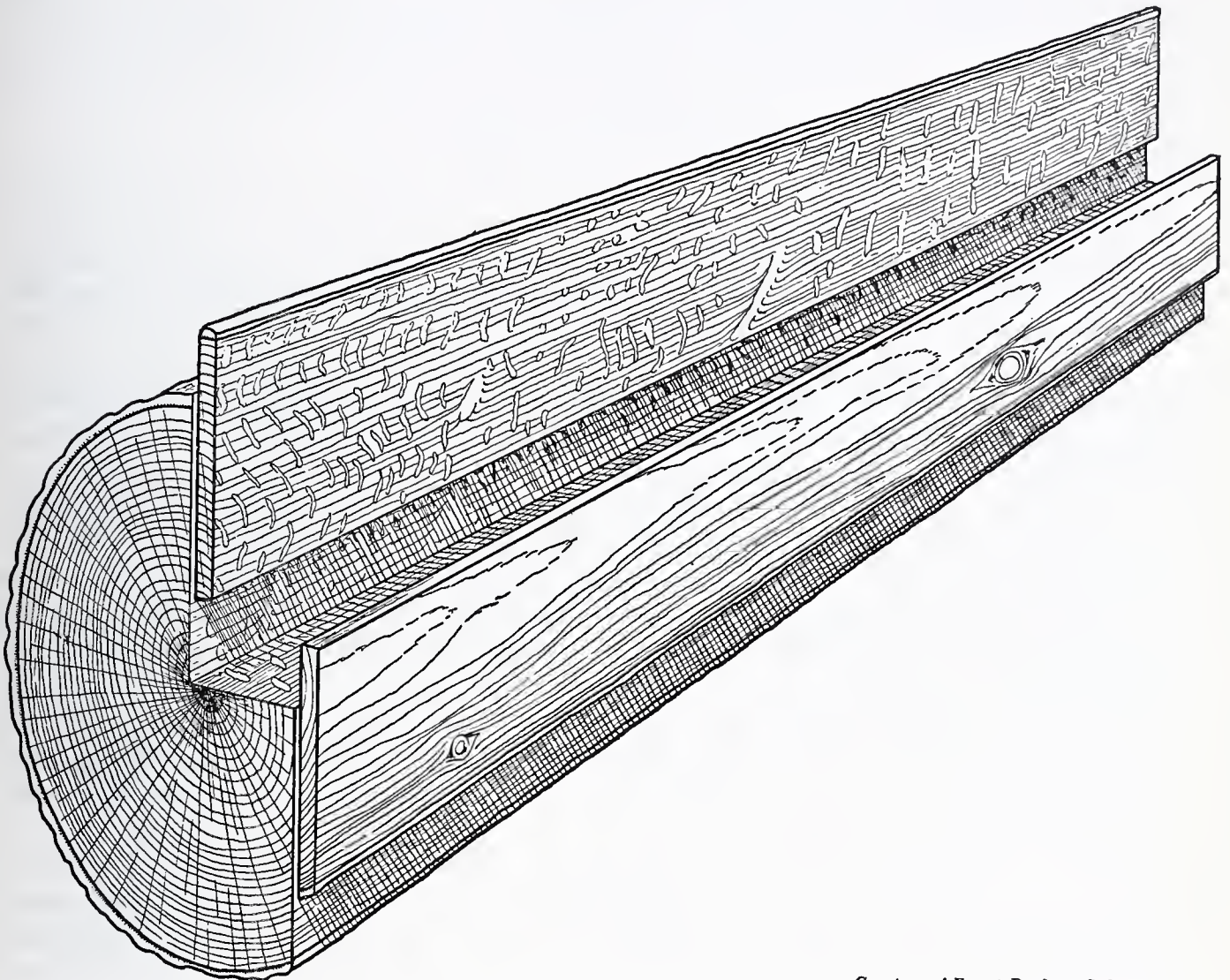
The figure developed by quarter-sawing varies in the different species. In some woods, such as poplar, gum, etc., the wood rays are small and hardly visible to the naked eye. In others, like oak and sycamore, the fleck is rather large. The more parallel to the wood ray the log is cut, the more perfect will be the figure produced. Frequently the term "fleck" is applied to the wood ray.

The hardwoods are more frequently quarter-sawed than the softwoods. Quarter-sawed stock is spoken of as:

Quarter-sawed
Edge grain
Vertical grain
Rift-sawed lumber
Radial cut

In quartering some woods, a pronounced "ribbon stripe" is developed, and is quite noticeable in the gums, mahoganies, etc. Another reason for quarter-sawing is to secure a

hard surface which wears evenly and seldom splinters. Quartered stock shrinks less in width than plain-sawed and is subject to minimum shrinkage and warping. In seasoning, it does not check or split open so readily as plain-sawed lumber and can be dried more rapidly in a kiln by giving it more severe treatment.



Courtesy of Forest Products Laboratory

Illustration 11—A diagrammatic drawing depicting a quarter-sawed and a plain-sawed board, cut from an oak log. The type of lumber called quarter-sawed is cut, so far as practicable, in the manner in which the upper board of the drawing is cut, with one edge at the growth center of the tree, and the other edge at the bark. As a result, the medullary rays (wood rays)—seen as fine white lines on the one end of an actual log, but represented on the log end in the drawing by radiating black lines—run practically parallel with the faces of the board. The lower board of the diagram is plain-sawed. In cutting plain-sawed lumber, all boards are cut with their faces tangent to the annual rings. As a result, the medullary rays (wood rays) pass through most of the boards almost perpendicular to the faces, and are seen only as very fine, narrow streaks which form an insignificant part of the "grain."

Plain-sawed Lumber

Plain-sawed lumber is lumber which is cut more or less at right angles to the rays, or tangent to the annual rings. (See Illustration 11.) No particular attention is given to the log when being sawed, except to turn and cut it for grade.

Plain-sawed lumber is commonly termed:

Flat grain	Slash grain
Plain-sawed	Tangential cut

No effort is made to produce figure, except that developed by the rings and general structure of the wood.

Plain-sawed stock develops much less waste; the log can be cut more quickly and hence is cheaper to cut. Plain-sawed lumber develops a natural figure, caused by exposing the contrast between the spring wood and summer wood; such figure is quite noticeable in Douglas fir, yellow pine, and cypress. The knots produced tend to be round rather than spiked. Plain-sawed stock dries nore rapidly than quarter-sawed lumber under the same conditions, and does not collapse so easily in kiln-drying.

Grading Rules

Object and Basic Principles

The primary object of grading rules is to classify lumber, for commercial purposes, into various groups based upon quality, shape, and size. Lumber is made into a commercial, usable product through this classification.

It is obvious that if all trees grew identical, were free from all defects, had the same rate of growth, and contained the same amount of heartwood and sapwood, and in general were strictly comparable, all lumber produced would be identically the same. In this case there would be no need for grading rules.

As already discussed, no two pieces of wood cut from a tree or trees are identical. Wide variation exists, not only in structure, but in the types of defects.

Industry demands lumber of various kinds, qualities, properties, and sizes. Although the same species of tree may be found in different sections of the country, the same grading rules apply to lumber cut from that species, regardless of where it originates, the type of log from which it is produced, or the method of manufacture. Thus, manufacturers of a given species are able to compete on an equal price basis. The consumers, through such classification, can be assured of a standard product. It will, therefore, be seen that grading rules protect both the producer and the consumer and prevent confusion and misunderstanding in lumber purchasing.

The history and development of grading rules date back to 1764, in Sweden, where only four grades were then recognized, ranging from the best to the poorest. Grading rules in this country can be traced back to 1830, when white pine manufacturers established inspection and grading rules for northern white pine. They were similar to the old Swedish rules and were not considered entirely satisfactory. Gradually, other producers saw possibilities offered by standardized rules, but considerable study was required in order to create standards acceptable to both producers and consumers.

Chaos prevailed for a number of years; each mill had its own rules and interpreted grades differently. However, associations were organized later which gradually put into practice rules which limited confusion and misunderstanding in lumber purchasing. Impartial inspection service has been found to be of such value that today in the United States numerous inspection bureaus exist which are well known and respected.

Only a small percentage of lumber bought today is purchased on a "mill run" basis, and the development and general acceptance of commercial grading rules, and an increased demand for American Lumber Standards, answer well for the success of standard grading rules.

Types and Classifications of Grading Rules

For practical purposes, the fundamental basis of grades is the size, character, and number of defects, and lumber is separated accordingly. Grading rules are intended to separate lumber based upon its subsequent use. Two main classifications are now in effect:

(*a*) Hardwood grading rules (*b*) Softwood grading rules
(See Illustration 12.)

Perhaps the most apparent difference between the two is that the hardwood rules are based upon number, size, and kinds of defects and clear-face cuttings, while softwood lumber (except factory and shop grades) is graded upon the basis of the general utility of the piece in its entirety. This difference is perhaps due to the fact that a large percentage of hardwood lumber is ripped and crosscut into clear pieces at the fabricating plants, while 75 per cent or more of softwood lumber is used for construction purposes "as is." It is true, however, that some softwood lumber for mill products is recut for clear-face pieces (factory grades).

Defects are the primary basis for grade classification. In softwoods the size, location, number, types, and kinds of defects have a marked effect upon the interpretation of grading rules, particularly where lumber is to be used in its entirety and the strength utility of the pieces is concerned.

Defects as defined in hardwood and softwood grades are similar. The following represent a few of the most prominent types of defects: knots, knotholes, wane, insect holes, stain, decay, mismanufacture, pitch pockets, checks, splits, etc.

In the following discussion a brief synopsis will be found of hardwood grading rules as interpreted by the National Hardwood Lumber Association. There will also be found extracts from American Lumber Standards for softwood lumber. (See Illustration 13.)

Softwood grading rules should be carefully studied so that their exact interpretation will be understood. In general, types and sizes correspond to those indicated in American Lumber Standards for practically all of the softwood species.

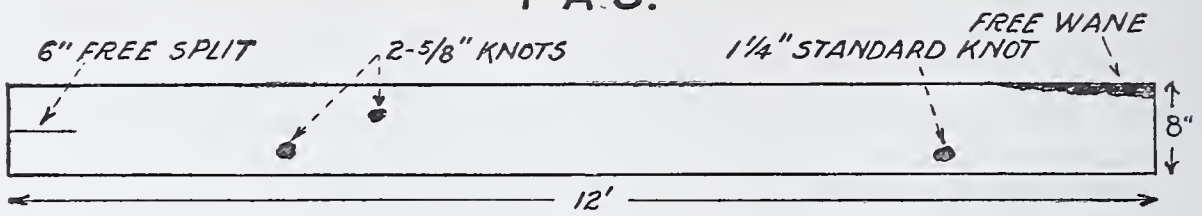
It must be remembered that the interpretation of grading rules depends largely upon the skill and experience of the inspector. It is true that while in hardwood measuring units clear-face cuttings may be figured with mathematical accuracy, many "line" boards are possible which require careful study and judgment in designating their respective grades.

Hardwood Grading Rules

The following data abstracted from *Rules for the Measurement and Inspection of Hardwood Lumber—Cypress, Veneers, and Thin Lumber and Plywood,* issued January, 1930, by the National Hardwood Lumber Association, will give salient points which are often of value to the consumer and fabricator of hardwoods. These data were chosen because of their importance in making clear some points which are frequently confused in hardwood lumber inspection. Actual standard grades have not been included. The above Association is glad at any time to furnish information or forward copies of these rules, upon request.

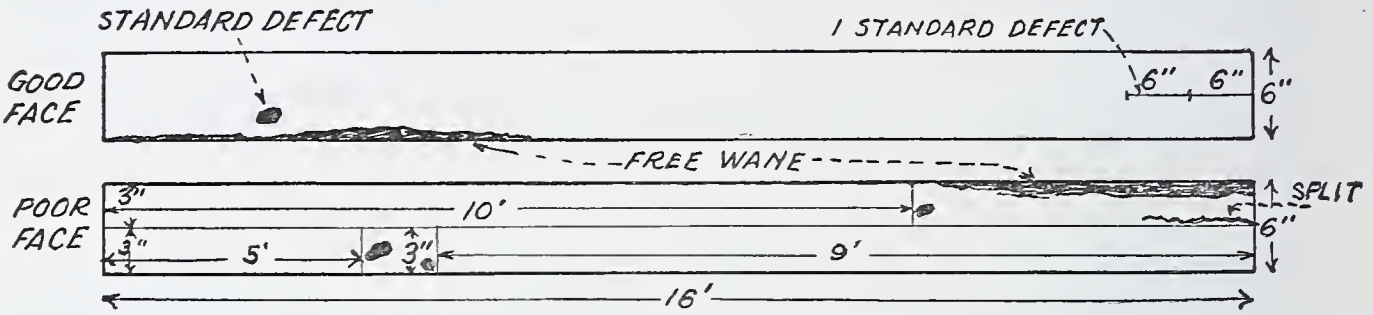
STANDARD HARDWOOD GRADES

F A S.



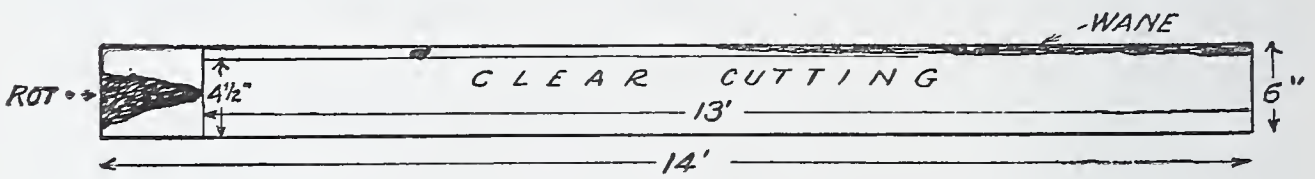
A

SELECT



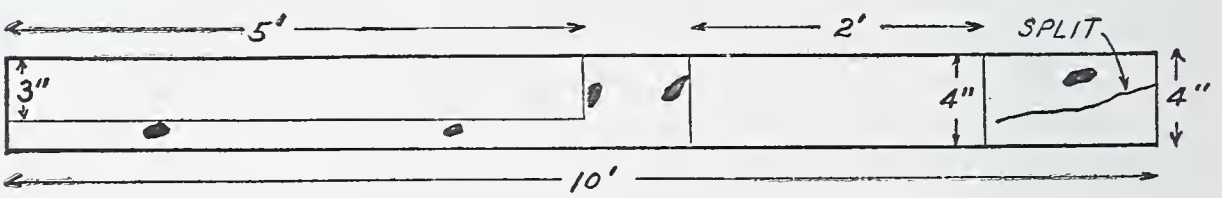
B

No 1 COMMON



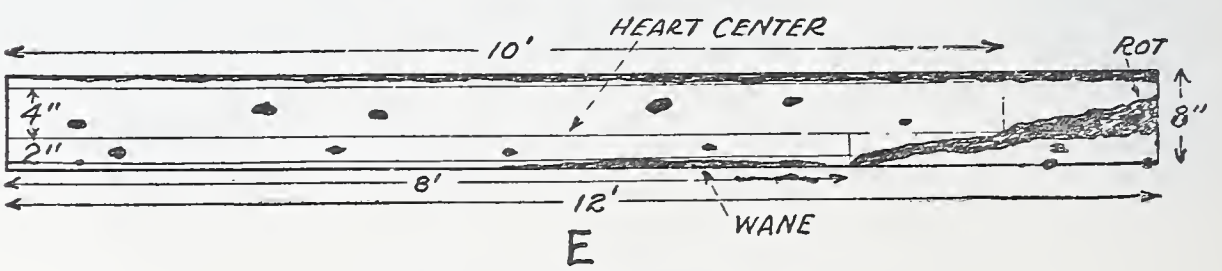
C

No 2 COMMON



D

No 3 COMMON



E

Illustration 12 (see opposite page).

On the opposite page are shown various grades of hardwood boards which serve to illustrate methods of classifying these boards into various standard grades.[1]

FAS

Inspection is made on the poor side of the board.

This board contains 8 board feet surface measure, and would be allowed two standard defects or their equivalent (split, wane, etc.). The two $\frac{5}{8}$" knots are the equivalent of 1 standard knot; the other knot would take up the other allowed defect. The balance of the board is clear, except for free wane. Therefore, this board would grade as a FAS.

(Note that in the grade of First and Seconds, defects are considered rather than clear face cuttings.)

Select

The good and poor sides of the board are shown. In order to grade as a Select, a board "6" and over wide, 8' and over long, must grade not below Seconds on the best face, and not below No. 1 Common on the reverse side."

This board contains 8 board feet surface measure, and is allowed two standard defects to grade as a *Second.* One $1\frac{1}{4}$" knot equals one standard defect; the other is taken out as excess split of 6" over 6" of free split (or equivalent of 6" at either end) allowed.

The other side of the board (the poor face) must grade a No. 1 Common. Pieces 5" to 7" wide, 7' to 11' long, must work $66\frac{2}{3}$ per cent clear face in not over two cuttings; 12' and over, in not over three cuttings. Three cuttings are allowed on this board. (See page 75 for definition of clear face cutting.)

64 units are required (see page 78 for methods of figuring units).

1 cutting	3" x 10'	= 30 units
"	3" x 9'	= 27 units
1 "	3" x 5'	= 15 units
Total		72 units

The total units which this board will cut are 72. Therefore, this side of board will cut No. 1 Common, and board is a Select.

No. 1 Common

The poor side of the board is depicted. "Pieces 5" to 7" wide, 7' to 11' long, must cut $66\frac{2}{3}$ per cent clear face in not over two cuttings; 12' and over long, in three cuttings." At first glance it would appear that this board would grade a Select, but the knot prevents, inasmuch as the cutting shown is not "the full width of the piece," but only $4\frac{1}{2}$" wide. Note excess wane.

The board contains 7 board feet surface measure, and must cut 56 units.

1 cutting $4\frac{1}{2}$" x 13' = $58\frac{1}{2}$ units

Therefore, board will grade as a No. 1 Common.

No. 2 Common

Poor side of board is shown. "Pieces 3" to 7" wide, 4' to 10' in length, must work 50 per cent clear face in not over three cuttings; 11' or over long, in not over four cuttings." (No cutting less than 3" wide and 2' long is allowed.)

This board contains 3 board feet surface measure, and in order to work a No. 2 Common, must contain 18 units.

1 clear face cutting	4" x 2'	= 8 units
1 " " "	3" x 5'	= 15 units
Total		23 units

The total units which this board will cut are 23.

Therefore, board will grade as a No. 2 Common.

No. 3 Common

Poor side of board shown. "All pieces must work 25 per cent *sound;* minimum width of cuttings $1\frac{1}{2}$", and no cutting considered which contains less than 36 sq. in. The board will not grade a No. 2 Common, due to lack of required size cuttings. (See page 75 for definition of *sound cuttings.*)

Board contains 8 board feet surface measure, and must cut 24 units.

1 sound cutting	2" x 8'	= 16 units
1 " "	4" x 10'	= 40 units
Total		56 units

The total number of units which this board will cut are 56.

Therefore, board will grade as a No. 3 Common.

[1] Sound and wormy grade not included.

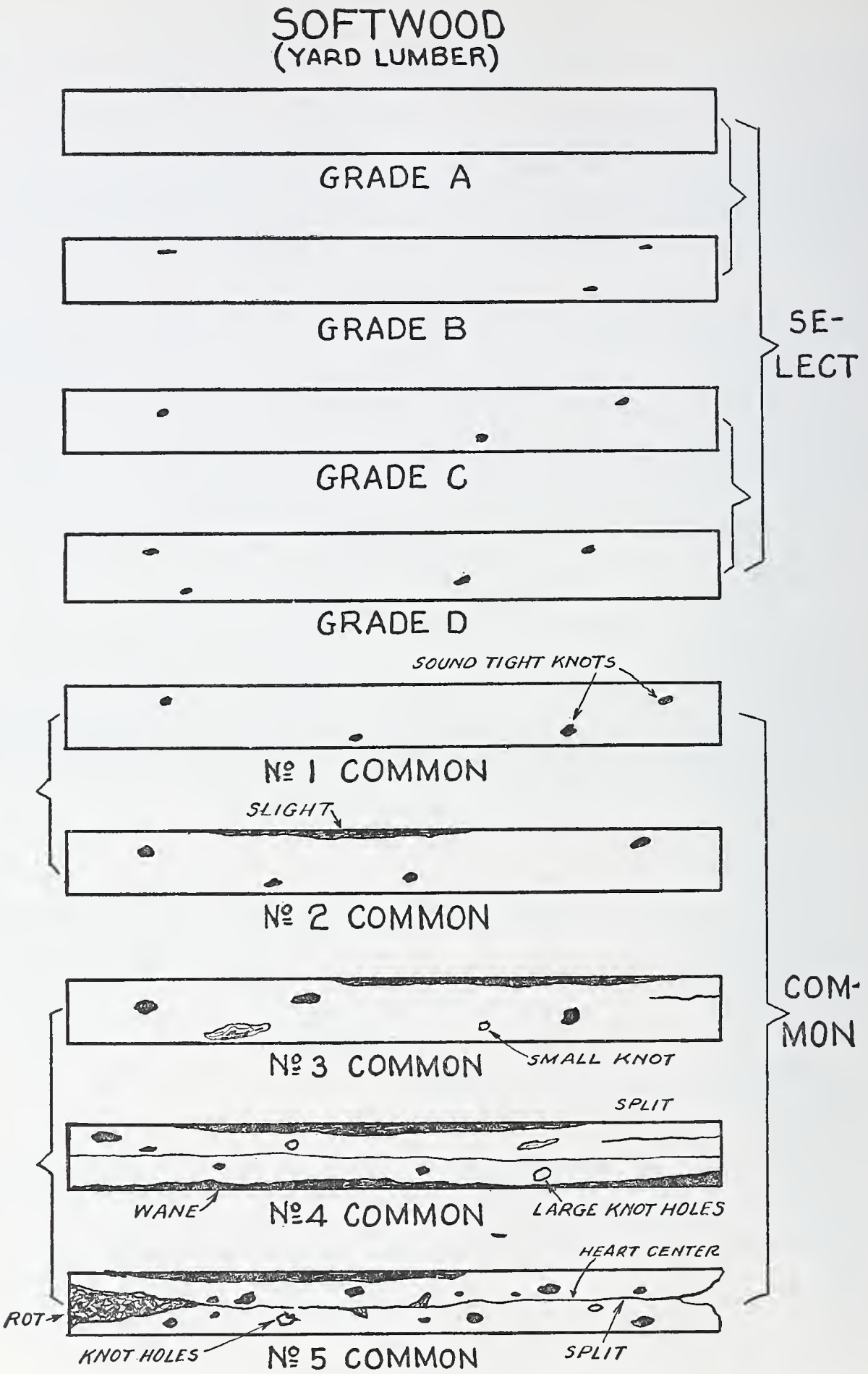


Illustration 13 (see opposite page).

On the opposite page are shown basic grade boards as interpreted by American Lumber Standards for yard lumber, illustrating the gradation and range between the "best" to the "poorest" board.

(In every instance, grading rules for the various softwood species should be consulted in order to ascertain size, amounts, etc., of various defects allowed in the different grades.)

Grades A, B, C, and D are known as Select, and include lumber of good appearance and finishing qualities.

Grades A and B are suitable for natural finishes, while Grades C and D are suitable for paint finishes.

Grade A

Practically free from defects.

Grade B

Allows a few small defects or blemishes.

Grade C

Allows a limited number of small defects and blemishes that can be covered with paint.

Grade D

Allows any number of defects or blemishes which do not detract from a finish appearance, especially when painted.

Grades 1, 2, 3, 4, and 5 are classed as Common lumber, and contain defects or blemishes etc., which detract from a finish appearance but which are suitable for general utility and construction purposes.

No. 1 Common and No. 2 Common are suitable for use without waste.

Nos. 3, 4, and 5 Common represent lumber permitting waste.

No. 1 Common

Sound and tight knotted stock. Size of defects and blemishes limited. May be considered water-tight lumber.

No. 2 Common

Allows large and coarse defects. May be considered grain-tight lumber.

No. 3 Common

Allows larger and coarser defects than No. 2 and occasional knot holes.

No. 4 Common

Low quality lumber admitting the coarsest defects, such as decay and holes.

No. 5 Common

Must hold together under ordinary handling.

Fees for Official Measurement and Inspection of Lumber

1. The following schedule covers all lumber less than 8/4 in thickness.
2. For all lumber 8/4 and thicker deduct 10¢ per thousand feet.

	Per 1,000 Ft.		Per 1,000 Ft.
Ash	$1.20	Magnolia	$1.20
Aspen	1.20	Mahogany	1.45
Basswood	1.20	Maple	1.20
Beech	1.20	Oak, Plain	1.20
Birch	1.20	Oak, Quartered	1.45
Buckeye	1.20	Poplar	1.20
Butternut	1.45	Sycamore	1.20
Cedar	1.70	Strips	1.45
Cherry	1.45	Tupelo and Black Gum	1.20
Chestnut	1.20	Walnut	1.45
Cottonwood	1.20	Willow	1.20
Cypress	1.20	Quartered woods not listed	1.45
Dimension Stock	Time Charge	Flooring, Ceiling, Partition, Siding, Trim, and all lumber worked to pattern	1.70
Elm, Soft	1.20	Surfaced lumber, add to fee for rough lumber	.25
Elm, Rock (or Cork)	1.45	Wagon Stock (except Box Boards)	1.45
Gum, Plain Red, Plain Sap, Quartered Sap	1.20	Woods not listed above	1.45
Gum, Red Figured or Quartered	1.45	Widths specified 10″ and wider, including Step Plank, add	.25
Hackberry	1.20		
Hickory and Pecan	1.45		

An additional charge will be made for the inspection of the above woods when badly mixed. When inspections made at loading point require sorting to obtain the stock desired for loading, the above fees apply to the entire quantity handled by the inspector.

When inspectors are required to mark the lumber an additional charge of 25¢ per 1,000 feet will be made.

When the inspection service desired necessitates trips away from the inspector's headquarters actual traveling and hotel expense will be charged. A charge will be made for time lost in traveling or time lost after the inspector has reported for service when due to lack of proper facilities for handling the lumber, lack of suitable stock, or due to other delays beyond the control of the inspector.

Minimum time charges are eight dollars per day for time lost in traveling during working hours, and fifteen dollars per day on the job. A minimum charge of four dollars will be made in all cases for inspecting small lots at headquarters points; at other points there will be an additional charge for time lost during working hours when the quantity inspected does not occupy a full day's time, or when the quantity offered for inspection at fee rates does not provide a minimum fee of fifteen dollars per day.

Veneer and Plywood: Owing to the variety of conditions under which veneer and plywood are inspected charge will be made for inspection on a per diem basis.

Important: When called upon by the Executive Office for advance check covering inspector's traveling expenses, members by making prompt response will avoid delay in securing service.

National Inspection Service

The National Hardwood Lumber Association maintains one or more licensed and bonded inspectors in the principal hardwood markets and producing centers of the United States and Canada. A list of Association inspectors, with their street addresses, is printed in every issue of the monthly Official Bulletin. The services of these inspectors are available for members subject to the Inspection Regulations, pages 7 to 10, inclusive.

Note.—The prime duties of the inspectors of this Association are to inspect lumber; they are not general business agents and if requested by members to attend to such duties as issuing or signing bills of lading, ordering or consigning cars, yarding or storing, will do so when convenient or possible, but only as an accommodation, and the Association accepts no liability on account of any errors which may develop through such accommodations.

Original National Inspection Regulations

I. All applications for Original National Inspection must be made by a member of the Association to the Secretary or a licensed inspector. Any member who applies for inspection on lumber which he has neither bought nor sold is subject to suspension or expulsion from the Association. Members will avoid delay by mailing requests for original inspection direct to the inspector nearest the point where the inspection is to be made, sending carbon copy to the Association, 2008 Straus Building, Chicago, Ill.

II. Inspectors are required to inspect the full amount of lumber contained in an original shipment, and they are expressly forbidden to apply National Inspection to a portion of a shipment after selections have been made therefrom, unless both seller and buyer agree thereto.

III. In the absence of instructions to the contrary, a National Inspector will inspect and measure lumber according to "Standard Inspection" and the "General Instructions" as provided by the rules in this book. In all cases in which any special inspection is to apply, either in the matter of grade or size, it is incumbent upon the shipper or party applying for inspection to furnish the National Inspector with a copy of the order (prices may be omitted) and a clear and definite interpretation of same as agreed to by the buyer and seller.

NOTE.—Special grades when clearly defined will be subject to the Association's guarantee but only to the extent the exceptions to the standard grades are noted on the certificate by the inspector; however, Association inspectors will not certify any shipments to be entirely free of worm holes, curly grain, checks, dote or stain, nor to be perfectly flat and straight, but will consider these conditions in the lumber as may otherwise be necessary to determine the grades specified. Association inspectors will not certify to texture, moisture content, degree of dryness or weight.

IV. When protection under the Association's guarantee is desired on lumber to be kiln dried after the original Association inspection has been applied, it is necessary that the inspector be so instructed. The inspector will then place on the lumber marks of identification which will be noted on the Certificate and the Certificate marked "For Kiln Drying." The inspector will also mark the surface measure on each board which measurement shall also be used in tallying and grading if reinspected after kiln drying. An extra fee of twenty-five cents per thousand feet will be charged for marking.

V. When an inspection by an authorized inspector of the National Hardwood Lumber Association is completed, the inspector shall deliver to the member requesting the inspection a certificate in duplicate, certifying to the amount and grade of lumber so inspected. This certificate is final for settlement between buyer and seller in all cases where an agreement as to the application of National Inspection exists between the parties.

VI. It should be thoroughly understood that neither this Association, nor any of its members, possesses authority to impose Official National Inspection in any of the markets, except through the mutual agreement of the parties at interest; and when such Official Inspection has been made, it is binding only upon those parties who agreed beforehand to recognize it in the individual transaction in which it is involved. A buyer or seller may desire National Rules of grading and measurement to apply to a contract and thus specify "National Rules to Govern," without necessarily obligating either party to the application of those rules by a licensed inspector of this Association. It is, therefore, absolutely necessary in any transaction involving the sale or purchase of lumber, in which a member of this Association relies upon the efficacy of the inspection department of the Association for the just protection of his interests, that it be clearly stated in the contract of sale or purchase that National Inspection is to prevail. The following form for such a clause in contracts of that nature is recommended:

The lumber is to be inspected according to the rules and regulations of the National Hardwood Lumber Association by a National Inspector.

VII. With the foregoing clause in a contract, the shipper may apply National Inspection at loading point, or it may be applied at destination. The point of inspection may be governed by the convenience in securing the services of a National Inspector.

VIII. If it is desired that the contract provide for National Inspection at destination in the event of a difference between the inspection of the seller and buyer, it is necessary that the contract contain a clause so specifying or else it can only be made binding by the mutual consent of both parties after a dispute has arisen. The following form is recommended when desiring to cover the above conditions in the contract:

The lumber is to be inspected according to the rules and regulations of the National Hardwood Lumber Association, and in the event of disapproval of the inspection of the shipper, inspection by a National Inspector shall govern.

IX. When National Inspection is agreed to either in a sales or purchase contract, or subsequently, the arrangement should also provide for the disposition of the expense of the inspection as such disposition is entirely subject to arrangement between buyer and seller. It may be divided between them, or may be borne entirely by either, but a bill of the expense as set forth on Page 5 will be rendered by the Secretary against the member calling for the inspection, which bill is due and payable upon demand.

X. In all transactions in which the official bonded inspection certificate of the Association is the agreed basis between buyer and seller and the inspection is applied at point of shipment the SHIPPER, in order to obtain the full protection of the Association, must PROMPTLY FORWARD ONE COPY OF THE INSPECTION REPORT TO THE BUYER. If copy of the certificate is not in the hands of the buyer at time of arrival at destination of the shipment covered by the certificate, the seller cannot insist upon settlement on basis of such certificate.

XI. In all transactions in which the official bonded certificate of the Association is the agreed basis between buyer and seller and the inspection is applied at destination, the buyer in order to obtain the full protection of the Association must forward copy of the certificate promptly to the shipper and not later than three days after receipt of certificate from the inspector.

XII. Where a member makes a sale to a buyer who is not a member, such sale being based on Official National Inspection and the buyer desires and it is so agreed that such inspection be applied at destination, it shall be the duty of the seller as a member of the National Hardwood Lumber Association to call for Official Inspection on the shipment within five days after receipt of notice of its arrival at destination.

XIII. If any member of the Association declines to recognize official inspection after agreeing to be governed by it, the Secretary is instructed on receipt of sufficient evidence of the repudiation to drop such member from the rolls; if any buyer not a member violates agreement to settle for any shipment on the basis of Official National Inspection, the name of such buyer will be published in the Official Monthly Bulletin of the Association together with a statement of the facts in the case.

XIV. When original National Inspection is made at loading point according to agreement it shall be considered a repudiation of the inspection if the buyer fails to settle in full for the shipment as shown by the Association Certificate.

XV. When original National Inspection is made at destination according to agreement, it shall be considered a repudiation of the inspection if the buyer fails to settle in full for that portion of the shipment which the Association Certificate shows to be in accordance with the specifications of the order, provided that the portion of the shipment which is below the grades specified does not amount to more than 5% of the total footage of the shipment. Off-grade stock may be held for the disposition of the shipper or accepted in accordance with any adjustment upon which buyer and seller may be able to agree. (This article is not to be construed as authority to reject each and every shipment containing 6% or more off-grade. The rights of the buyer and seller should be determined in such cases by consideration for the circumstances in each individual transaction. The National Hardwood Lumber Sales Code provides a basis on which to adjust such shipments when the Sales Code has been made a part of the sales contract.)

National Reinspection Regulations and Guarantee

1. No complaints nor claims will be considered except the lumber is subjected to official reinspection under these regulations.

II. Should either party to the transaction involving an original inspection be dissatisfied with the result of the same, it is within his right, whether a member of the Association or not, to call for reinspection, provided stock is intact and located within the United States or Canada.

This class of inspection can only be obtained by applying to the Secretary.

III. All applications for reinspection shall be made within ten days from receipt of lumber at destination, provided the original inspection was made at point of shipment, or within ten days from date of original inspection, if same is made at destination.

IV. Upon approval of application for the reinspection of a block of lumber for which a certificate has been regularly issued by a National Inspector, the chief inspector shall proceed as promptly as possible to reinspect the lumber in person, or by a deputy, other than the inspector making the original inspection.

V. If the reinspection results in a difference in favor of the party complaining, of more than four per cent in money value from the original inspection, the party complaining may receive the amount of such difference directly from this Association by sending to the Secretary an itemized statement showing in detail the items and amounts as shown on the original certificate and the reinspection certificate. No claim on reinspection will be paid until prices placed on off-grade items are approved by the Executive Committee. The Association does not under any circumstances take possession of the lumber or dispose of it.

VI. In all cases where claims develop on the four per cent money value clause, the Association will assume the actual labor cost of handling lumber for reinspection but not to exceed the fee per thousand feet charged by the Association for conducting the original inspection. No claim will be approved and passed for payment where handling charges are in excess of these rates. In cases where claims are approved, the Association charges for the reinspection will be canceled. The Association assumes no liability on account of demurrage, or for any expense other than herein provided.

VII. If the difference does not exceed four per cent the party demanding the reinspection shall pay all expenses connected therewith.

VIII. This guarantee does not apply on lumber inspected and piled down at point of shipment and reinspected at destination; nor on lumber that has been dressed or worked after original inspection has been applied. Guarantee will apply on certificates denoting green lumber except that stain and season checks, warp and twist shall be disregarded in conducting reinspection when ordered on the complaint of the buyer. The Association reserves the right to decline official reinspection on lumber shipped in leaky cars or delayed beyond a reasonable period in transit, or which does not arrive at destination in its original container.

IX. This guarantee applies on lumber kiln dried after the original inspection has been applied only when the original inspector was notified before inspection that the lumber was to be kiln dried, and has marked the boards for identification and measurement as prescribed in the Original Inspection Regulations, Article IV, page 7. Reinspection will then be granted on complaint of the buyer when requested in accordance with the same regulations governing reinspection of air dried lumber except that it shall be understood the Association assumes no liability for any shortage in measurement, scant thickness, or proper kiln drying and that in conducting reinspection the inspector will tally and grade on the measurement marked on the boards before kiln drying, will consider only the nominal thickness, and will disregard checks, honeycomb, splits and warp in grading.

General Instructions

1. Inspectors are instructed to study these rules carefully and use their best judgment in applying them.

2. All lumber shall be inspected according to these rules as defined under General Instructions and Standard Inspection unless otherwise specified. The rules defined under Special Inspection shall be applied only when specified in the contract between buyer and seller. The rules under Standard Inspection and Special Inspection shall not be applied under any contract which specifies grade names different from those listed herein except by special agreement between buyer and seller.

3. Exceptions to the General Instructions are stated under the caption of the respective woods and grades.

4. Lumber must be inspected and measured as the inspector finds it, of full length and width. He shall make no allowance for the purpose of raising the grade. The surface grade as determined by the number of defects or cutting yield shall first be established by the inspector, after which the thickness shall be determined. (For example, a board which grades No. 1 Common on its surface but which is not full 5/4 thick in a portion of its area including a portion of the No. 1 Common cuttings, must be reported as 4/4 No. 1 Common rather than 5/4 No. 2 Common, even though it may yield the required cuttings for No. 2 Common in full 5/4 thickness.) After grade and thickness have been determined special features, such as the amount of forty-five degree radial grain for classification as quarter-sawn lumber, and the amount of figure as specified for figured woods and some quartered woods, shall be considered.

5. Inspection must be made from the poor side of the piece.

6. These rules define the poorest piece in any given grade, but the respective grades must contain all pieces up to the next higher grade.

7. All widths, lengths and thicknesses mentioned in these rules shall be inclusive.

Manufacture

8. Lumber should be properly manufactured of good average widths and lengths. It should be edged and trimmed carefully to produce the best possible appearance while conserving the usable product of the log. It must be of standard thickness when shipping dry, with the exception that in the cutting grades, the percentage not included in the required cuttings may be scant in thickness, provided that cuttings are of standard thickness and there is no greater variation in the thickness of the board than is allowed in the rule describing miscut lumber. Dressed lumber sold or shipped as rough lumber shall be accepted and inspected under the rules governing rough lumber, but not to exceed 25% of any shipment.

Miscut Lumber

9. Lumber having greater variation in thickness between any two points than shown in the following table must be measured for thickness at the thinnest part and classed as miscut, and must be graded and reported as such:

1/16″ in thicknesses of 1/2″ or less
1/8″ in thicknesses of 5/8″ and 3/4″
1/4″ in thicknesses of 1″ to 2″
3/8″ in thicknesses of 2 1/2″ to 3 1/2″
1/2″ in thicknesses of 4″ to 6″

Minimum Widths

10. Ninety per cent of the minimum widths mentioned in all grades of lumber must be full width; the remaining ten per cent may be 1/4″ scant in width. This rule applies to each stock width and to any specified width.

Standard Lengths

11. Standard lengths are 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, and 16 feet but not over 50 per cent of odd lengths will be admitted.

Standard Thicknesses

12. Standard thicknesses are 3/8, 1/2, 5/8, 3/4, 1, 1 1/4, 1 1/2, 2, 2 1/2, 3, 3 1/2, 4, 4 1/2, 5, 5 1/2, and 6 inches. One inch and thicker may also be expressed in quarter inches as follows: 4/4, 5/4, 6/4, 8/4, 10/4, 12/4, 14/4, 16/4, 18/4, 20/4, 22/4, and 24/4.

NOTE: For lumber thinner than 3/8″ see veneer and plywood rules, pages 71 to 83.

13. Standard thicknesses for surfaced lumber are as follows:

Rough	*Surfaced*	*Rough*	*Surfaced*	*Rough*	*Surfaced*
3/8″ S2S	to 5/16″	1 ″ S2S	to 13/16″	2½″ S2S	to 2¼″
½″ S2S	to 7/16″	1¼″ S2S	to 1 1/16″	3 ″ S2S	to 2¾″
5/8″ S2S	to 9/16″	1½″ S2S	to 1 5/16″	3½″ S2S	to 3¼″
¾″ S2S	to 11/16″	2 ″ S2S	to 1¾″	4 ″ S2S	to 3¾″

14. Lumber surfaced on one side only must be 1/16″ full of the above surfaced thicknesses.

Measurement and Tally

15. In the measurement of lumber of random widths fractions of over one-half foot, as shown on the board rule, must be counted up to the next higher figure; fractions of exactly one-half foot and less, as shown on the board rule, must be counted back to the next lower figure. Fractional lengths in standard grades must be measured as of the next lower standard length.

NOTE: Unless otherwise specified, when reference is made to percentages, calculation shall be on the basis of board feet, except that on lumber less than 1″ thick it shall be on the basis of surface feet, and not on the number of pieces.

16. Tapering lumber in standard lengths must be measured one-third the length of the piece from the narrow end.

17. A piece tally in feet must be made of all lumber. All random width lumber of standard grades and thicknesses must be tallied face or surface measure and this tally must be the number of feet, board measure, of 1″ lumber. If the lumber is thicker than 1″, then the tally so obtained must be multiplied by the thickness as expressed in inches and fractions of an inch. All lumber less than 1″ must be counted face measure.

18. When strips or stock-widths are measured, a tally showing widths and lengths must be made.

19. All dimension stock of specified sizes shall be counted on the basis of exact contents board measure.

Season Checks

20. Season checks which are so serious in character as to damage the lumber shall be considered defects, but ordinary season checks shall not be considered defects.

Sap Wood

21. There is no restriction to bright sap wood except as otherwise specified.

Stain

22. Stain shall be considered a defect unless it will dress out in surfacing to the standard thickness for surfaced lumber, except in grades of woods where it specifically states stain is no defect.

22B. Where order or contract specifies free from stain, stain shall be considered a defect unless it will dress out in surfacing to standard thickness for surfaced lumber.

22C. Sound stain, including spots in which the disintegration has not proceeded far enough to soften or otherwise change the hardness of the wood perceptibly, shall be admitted in grades of woods where it specifically states sound stain is no defect, or in grades of woods specifying sound cuttings.

Burls

23. Burls that do not contain knots or unsound centers shall not be considered defects.

Definitions

24. The word Cutting as used in these rules means a portion of a board or plank obtained by cross-cutting, by ripping, or by both. A cutting must be flat enough to surface two sides to standard surfaced thickness after it has been removed from the board.

25. The term Clear Face Cutting as used in these rules means a cutting having one face clear and the reverse face sound. The clear face of the cutting must be on the poor side of the board except when otherwise specified.

26. The term Sound Cutting, as used in these rules, means a cutting free from rot, heart-center and shake and free from other defects which materially impair the strength of the cutting. Will admit one ½″ or two ¼″ average diameter cavities, showing on one side only of a cutting, but not

more than one such defect shall be admitted to each 12 units (144 square inches) of cutting. This applies to one side only of Sound Cutting and to the reverse side of Clear Face Cutting.

27. The term Good Edge, as used in these rules, means an edge free from unsound defects except a slight amount of wane not exceeding one-third the length, one-third the width, and one-third the thickness of the piece, or its equivalent in other defects.

Quartered Woods

28. In woods where figure is not required, Firsts and Seconds shall be considered quartered when the radial grain is at an angle of forty-five degrees or less with 80% of one face of the piece in the aggregate. Selects shall be considered quartered when the radial grain is at an angle of forty-five degrees or less with 80% of the face side of the piece in the aggregate. No. 1 Common and No. 2 Common shall be considered quartered when one face of each required cutting shows the radial grain at an angle of forty-five degrees or less with 80% in the aggregate.

28A. In all quartered woods ten per cent may be 1/16″ scant on one edge provided the other edge is full standard thickness when shipping dry, in thickness up to and including 6/4; in thicknesses of 8/4 and thicker ten per cent may be 1/8″ scant on one edge provided the other edge is full standard thickness when shipping dry.

Standard Defects

Paragraphs 29, 30A, 31, 32 and 33 each describe one standard defect.

29. One knot 1¼″ in diameter.

30A. When located away from edges and ends where they cannot be admitted as the equivalent to wane defects, the following shall be considered as one defect:

Four pin worm holes or their equivalent equals one defect.

Three spot worm holes or their equivalent equals one defect.

Two 5/8″ diameter knots or their equivalent equals one defect.

Not more than two standard defects of this character can be admitted to the piece; each additional pin worm hole or spot worm hole or 5/8″ knot shall be considered one additional standard defect.

30B. Defects larger than one standard defect, excepting wane and split, shall be considered on the following average diameter measurement:

2½″ knots or their equivalent shall be 2 standard defects

3¾″ knots or their equivalent shall be 3 standard defects

5″ knots or their equivalent shall be 4 standard defects

31. One split equal in length in inches to the surface measure of the piece in feet and diverging not more than 1″ to the foot in length.

32. Wane or its equivalent in other defects, 1″ wide, one-sixth the length of the piece along the edges, or its equivalent at one or both ends. In the wane defect, wane may extend through the full thickness of the piece showing on both faces.

33. Worm-, Grub-, Knot-, and Rafting pinholes, not exceeding in extent one standard knot defect described above.

Equivalent Defects

34. Heart-center and other defects not defined as standard defects, that do not damage the piece more than the standard defects allowed, are equivalent defects and must be so considered by the inspector. Wherever heart-center is mentioned it shall be understood that reference is made to the small soft core (pith) occurring in the structural center of the log.

Surfaced Lumber D2S

Surfaced lumber D2S shall be inspected according to the standard grades under the caption of the respective woods, with the following exceptions:

Firsts and Seconds

Inspection shall be made from the good face. The reverse side will admit one additional standard

defect or its equivalent. Slight chipped or torn grain 6″ long by the width of the piece or its equivalent on the face side shall be admitted. Slight stain shall be admitted on the reverse side and torn or chipped grain not exceeding one-third the surface area in the aggregate shall be admitted on the reverse side.

Poplar Saps

Poplar Saps shall be subject to the exceptions stated under Firsts and Seconds.

Selects

Slight chipped or torn grain 12″ long by the width of the piece in the aggregate, or its equivalent, will be admitted on the good face. Torn or chipped grain will be admitted on the reverse side.

The "Clear" Cutting Grades

In the clear cutting grades such as Shop Cypress, chipped grain on one side of the cuttings shall not be considered a defect.

The "Clear Face" Cutting Grades

Inspection shall be made from the good face; the reverse side of the cuttings must be sound.

Slight chipped grain 18″ long by the width of the piece or its equivalent on the good face shall not be considered a defect.

The "Sound" Cutting Grades

The sound cutting grades, including Cypress Common and Boxing shall be inspected according to the rules for rough lumber. Chipped grain and slight skips in surfacing shall not be considered a defect.

Surfaced Lumber D1S

Lumber surfaced on one side shall be inspected according to the rules governing lumber dressed two sides, except that inspection shall be made from the dressed face.

Surfaced Lumber "Hit or Miss"

Lumber ordered dressed hit or miss shall be inspected as rough lumber unless otherwise specified, except that the same allowances for chipped and torn grain as specified in the rules for lumber dressed two sides shall apply.

Special Inspection

No. 1 Common and Better

No. 1 Common and Better means the full run of the logs with all grades below No. 1 Common excluded.

Log Run

"Log Run" means the full run of logs, with all grades below No. 2 Common excluded.

Mill Run

Mill run means the full run of the logs, No. 3 Common and Better.

No. 1 Common Face

No. 1 Common Face is the same as the standard grade of No. 1 Common, except that inspection shall be made from the good face. The reverse side of the cuttings must be sound.

No. 2 Common Face

No. 2 Common Face is the same as the standard grade of No. 2 Common, except that inspection shall be made from the good face. The reverse side of the cuttings must be sound.

No. 2 Common Clear Cutting

Where the No. 2 Common grade specifies sound cuttings, a special grade of No. 2 Common may be made, specifying clear face instead of sound cuttings. Sound stain and bird pecks when admitted in the cuttings of the No. 1 Common grade of the respective woods, shall also be admitted in the cuttings of this grade on the same basis.

No. 2 Common Sound Cutting

Where the No. 2 Common grade specifies clear cuttings, a special grade of No. 2 Common may be made, specifying sound instead of clear face cuttings.

No. 3-A and No. 3-B Common

No. 3-A Common must work 33⅓% clear face in cuttings not less than 3 inches wide by 2 feet long, graded from the poor side of the piece. This grade will also admit pieces which grade not below No. 2 Common on the good face, the reverse side of the cuttings to be sound. No. 3-B Common consists of all No. 3 Common below the grade of No. 3-A Common.

Short Methods in Applying Inspection Rules

Figuring the percentage of cuttings. The most practical short method is the Unit Method. The unit is 12 square inches, or a piece 1″ wide and 1 ft. long.

Multiply the width in inches of each cutting by its length in feet; add the products thus obtained and the result will be the number of units of cutting in the board.

To determine the number of units required for 91⅔% cutting, multiply the surface measure of the board as tallied under paragraph 15, page 13, by 11; for 83⅓% cutting, multiply by 10; for 75% cutting, multiply by 9; for 66⅔% cutting, multiply by 8; for 60% cutting, multiply by 7⅕; for 50% cutting, multiply by 6; for 40% cutting, multiply by 4⅘; for 33⅓% cutting, multiply by 4; for 30% cutting, multiply by 3⅗; for 25% cutting, multiply by 3; for 20% cutting, multiply by 2⅖.

For example, suppose a board 9⅜″ wide by 16 ft. long has the following cuttings:

8½″ × 6 ft. = 51 units
3″ × 9½ ft. = 28½ units
4″ × 2¾ ft. = 11 units
3″ × 3⅓ ft. = 10 units

Total 100½ units. The board contains exactly 12 ft. surface measure, and the number of units required for 66⅔% cutting is 8 × 12 = 96 units; this board therefore contains more than 66⅔% cutting.

If this board is Oak, and if the above cuttings are clear face cuttings as defined in the rules, and if the clear face of each cutting is found on the poor side of the board, and if the board does not contain heart center for more than half its length, the grade is No. 1 Common; however, if the above cuttings contain an excessive amount of the streaks that sometimes occur in the heartwood of oak, the board must be lowered one grade and classed as No. 2 Common.

To determine one-sixth the length of a board, multiply its length in feet by 2; the results will be the required number of inches; thus, one-sixth the length of a 12 ft. board is 24 inches, one-sixth of 13 ft. is 26 inches, etc. This is useful in determining free wane and the amount of wane constituting a standard defect.

To determine one-third the length of a board, multiply its length in feet by 4; the result will be the required number of inches.

To determine one-fourth the length of a board (in grading Wide No. 1, and in applying the restriction as to heart center in No. 2 Common) multiply its length in feet by 3; the result will be the required number of inches.

To determine one-tenth the length of a board (in grading Panel) multiply its length in feet by 1⅕; the result will be the required number of inches; thus, one-tenth the length of a 10-ft. board is 1⅕ times 10 = 12 inches; one-tenth of 16 ft. is 19⅕ inches, etc.

To determine the amount of thin lumber obtained by resawing a given amount of various thicknesses:

For 5/4 resawn once, multiply the original surface measure by 2

For 6/4 resawn once, multiply the original surface measure by 2; resawn twice, multiply by 3; resawn three times, multiply by 4

For 8/4 resawn twice, multiply original surface measure by 3

When lumber has been resawn and sold as such the pieces should be kept together in pairs as obtained from original piece, inspected from its outer surfaces and tallied as one piece; when the pieces are not kept in pairs and it is not possible to inspect them together, then each piece must be inspected as thin lumber, but before applying such inspection at destination the buyer should consult the shipper and advise him of conditions.

To determine the amount of 8 to 11 ft. lengths constituting the standard percentage in the grade of Firsts and Seconds, divide the amount of 12 ft. and longer by 3. The result will be 25% of the total. Example: 12,000 ft. of 12 ft. and longer, divided by 3 equals 4,000 ft.; total 16,000 ft. Twenty-five per cent of 16,000 equals 4,000 ft.

Tallying on 12 Ft. Basis

The terms "export tally," width and length tally" and "tally on 12 ft. basis" are synonymous, and are used to denote the method of measurement required by foreign buyers. Inasmuch as our rules do not define this method of tallying, the term "tally on 12 foot basis" is more definite, because the width of 12 foot lumber is the same as the surface measure, and the method of tallying the surface measure is clearly defined in our rules. On this basis the lengths are tallied separately, and fractions of ½" or less in width are dropped, and fractions of over ½" are counted up to the next higher figure. After the tally is figured up, the proper fraction is added or subtracted in order to obtain the correct measure, thus: for 4 ft. lengths, divide the total by 3; for 6 ft. divide by 2; for 8 ft. subtract ⅓; for 9 ft. subtract ¼; for 10 ft. subtract ⅙; for 11 ft. subtract 1/12; for 13 ft. add 1/12; for 14 ft. add ⅙; for 15 ft. add ¼; for 5 ft. and 7 ft. multiply by the length and divide by 12.

This method of tallying should not be confused with tallying stock widths such as 1 x 6, 1 x 8, etc.

To determine average width of lumber without tallying on 12 ft. basis: Tally the surface measure of each piece in feet in separate column of each length, and after the columns are totaled the proper fraction is added or subtracted to change the surface feet to surface inches. When the surface measure has been translated to inches in width, divide by the number of pieces on the tally and the result is the average width in inches.

Thus: For 4 ft. length, multiply surface feet by 3, for 6 ft. multiply by 2; for 8 ft. add ½; for 10 ft. add ⅕; for 12 ft. the surface feet is the same as surface inches; for 14 ft. subtract 1/7; for 16 ft. subtract ¼. This method is based on 12 inches, and to determine width of odd lengths it is only necessary to add or subtract the proper fraction.

Softwood Grading Rules

The following extract is taken from "American Lumber Standards for Softwood Lumber." Regional Association grading rules should be consulted for their interpretation of various grades.

Lumber

In accordance with the unanimous action on December 12 and 13, 1923, April 22, 1924, May 1, 1925, April 27, 1926, and May 3, 1928, of the general conferences of representatives of manufacturers, distributors, wholesalers, retailers, and users of lumber, and representatives of architects, engineers, and general contractors named herein, and with similar action on December 7, 1928, of the Central Committee on Lumber Standards, acting with the delegated authority of the general conference, the United States Department of Commerce, through the Bureau of Standards, recommends that recognized classifications, nomenclature, basic grades, seasoning standards, sizes, uniform workings, description, measurement, tally, shipping provisions, grade marking, tally cards, and inspection of lumber be established as follows:

American Lumber Standards

SOFTWOOD LUMBER

1. To the extent to which differences in quality of timber, in conditions of manufacture, and in the uses to which the product is put, will, in practical application, permit, the basic provisions for the grading of lumber shall be uniform.

I. Lumber Classifications

2. For the purposes of simplification of sizes and grades and of equalizing, among species used for similar general purposes, the grades of a similar name, lumber shall be classified by principal uses into (*a*) *yard lumber*, (*b*) *structural material*, (*c*) *factory and shop lumber*.

1. Use Classification

3. Lumber is the product of the saw and planing mill not further manufactured than by sawing, resawing, and passing lengthwise through a standard planing machine, crosscut to length and matched.

4. Lumber is classified as (*a*) *yard lumber*, (*b*) *structural material*, and (*c*) *factory and shop lumber*. Different grading rules may apply to each class of lumber.

(*a*) *Yard lumber.*—Lumber that is less than 5 inches in thickness and is intended for general building purposes. The grading of yard lumber is based upon the use of the entire piece.

(*b*) *Structural material.*—Lumber that is 5 inches or over in thickness and width. The grading of structural material is based upon the strength of the piece and the use of the entire piece.[1]

(*c*) *Factory and shop lumber.*—Lumber intended to be cut up for use in further manufacture. It is graded on the basis of the percentage of the area which will produce a limited number of cuttings of a specified, or a given minimum, size and quality.

2. Size Classification

YARD LUMBER

5. (*a*) *Strips.*—Yard lumber less than 2 inches thick and under 8 inches wide.
(*b*) *Boards.*—Yard lumber less than 2 inches thick, 8 inches or over in width.
(*c*) *Dimension.*—All yard lumber except boards, strips, and timbers; that is, yard lumber 2 inches and under 5 inches thick, and of any width.[1]

(1) Planks: Yard lumber 2 inches and under 4 inches thick and 8 inches and over wide.
(2) Scantlings: Yard lumber 2 inches and under 5 inches thick and under 8 inches wide.
(3) Heavy joists: Yard lumber 4 inches thick and 8 inches or over wide.

STRUCTURAL MATERIAL

(*d*) *Timbers.*—Lumber 5 inches or larger in least dimension.

3. Manufacturing Classifaction

6. Manufactured lumber is classified as (*a*) rough, (*b*) surfaced, and (*c*) worked.
(*a*) *Rough lumber.*—Undressed as it comes from the saw.
(*b*) *Surfaced lumber.*—Lumber that is dressed by running through a planer. It may be surfaced on one side (S1S), two sides (S2S), one edge (S1E), two edges (S2E), or a combination of sides and edges, (S1S1E), (S2S1E), (S1S2E), or (S4S).
(*c*) *Worked lumber.*—Lumber which has been run through a matching machine, sticker, or molder. Worked lumber may be (1) matched, (2) ship-lapped, or (3) patterned.

(1) Matched lumber: Lumber that is edge dressed and shaped to make a close tongued and grooved joint at the edges or ends when laid edge to edge or end to end.
(2) Ship-lapped lumber: Lumber that is edge dressed to make a close rabbetted or lapped joint.
(3) Patterned lumber: Worked lumber that is shaped to a patterned or molded form.

II. Nomenclature of Commercial Softwoods

7. The standard commercial names for lumber cut from the principal species of softwoods, as shown in Appendix A (p. 27), shall be used in the formulation of lumber grading rules and in the construction of contracts and the terms of purchase and sale of American Standard lumber.

III. Yard Lumber

8. The term "yard lumber" as here used means lumber that is manufactured and classified into those sizes, shapes, and qualities required for ordinary construction and general-purpose uses. (Heavy

[1] Dimension (planks and joists) to be used where working stresses are required should be considered and graded as structural material. (See IV, Structural Material, pp. 11 to 19.)

material for structural purposes, softwood factory and shop lumber, hardwood factory lumber, and other special-use materials are not considered yard stock.)

1. Grade Standards

9. On the basis of quality, yard lumber is divided into two main divisions: (*a*) Select lumber and (*b*) Common lumber. These are again divided into two classes: Select lumber into (1) that suitable for natural finishes and (2) that suitable for paint finishes; Common lumber into (1) that which can be used without waste and (2) that which permits some waste. Each of these four classes is further divided into quality classes or grades.

SELECT LUMBER

10. Lumber which is generally clear, containing defects limited both as to size and number, and which is smoothly finished and suitable for use as a whole for finishing purposes or other uses in which large, clear pieces are required, shall be considered *select lumber.*

11. Two classes shall be recognized. The first shall be suitable for natural finishes. The second class permits similar defects, and, in addition, blemishes of somewhat greater extent than those of the first class, but of a type which can be covered by paint.

Grade names: A, B, C, and D.

COMMON LUMBER

12. Lumber containing numerous defects and blemishes which preclude it from use for finishing purposes, but which is suitable for general utility and construction purposes, shall be considered *common lumber.*

13. Two general classes shall be recognized. The first shall be suitable for use as a whole for purposes in which surface covering or strength is required. Defects and blemishes permitted in this class must be sound. The second class permits very coarse defects which may cause waste in the use of the piece.

Grade names: No. 1 common, No. 2 common, No. 3 common, No. 4 common, and No. 5 common.

Dimension grade names: No. 1 common, No. 2 common, and No. 3 common.

TABLE 6

14. Basic Grade Classifications for Yard Lumber

Total products of a typical log arranged in series according to quality as determined by appearance.	*Select* Lumber of good appearance and finishing qualities	Suitable for natural finishes	Grade A—Practically free from defects
			Grade B—Allows a few small defects or blemishes
		Suitable for paint finishes	Grade C—Allows a limited number of small defects or blemishes that can be covered with paint
			Grade D—Allows any number of defects or blemishes which do not detract from a finish appearance, especially when painted
	Common Lumber containing defects or blemishes which detract from a finish appearance but which is suitable for general utility and construction purposes	Lumber suitable for use without waste	No. 1 common—Sound and tight knotted stock. Size of defects and blemishes limited. May be considered water-tight lumber
			No. 2 common—Allows large and coarse defects. May be considered grain-tight lumber
		Lumber permitting waste	No. 3 common—Allows larger and coarser defects than No. 2 and occasional knot holes
			No. 4 common—Low quality lumber admitting the coarsest defects, such as decay and holes
			No. 5 common—Must hold together under ordinary handling

DEFINITIONS OF DEFECTS AND BLEMISHES

15. The defects and blemishes, enumerated in the rules for grading yard lumber of any species under the American Lumber Standards, shall be defined within the limits of the "Definitions of Maximum Defects and Blemishes" as shown in Appendix B (p. 28).

GENERAL PROVISIONS

16. The grading of lumber can not be considered an exact science, because it is based on a visual inspection of each piece and on the judgment of the grade. The provisions of these specifications, however, are sufficiently explicit to establish 5 per cent below grade as a reasonable variation between graders.

17. All yard lumber is graded with reference to its suitability for general use as yard lumber. With this in view, each piece is considered and its grade determined by its general character, including the location and sum of all of its defects and blemishes. Material not conforming to standard sizes or grades shown herein and that intended for special uses shall be covered by special contract and inspection.

18. Except in dimension, the grade of yard lumber, rough or surfaced two sides, shall be determined from the better or face side of the piece, and lumber which is surfaced one side only shall be graded from the surfaced side.

19. The rules for yard lumber prescribe the number and extent of defects and blemishes permitted in the poorest pieces admissible in each grade. A grade should be representative, however, and not made up of only low-line pieces.

20. The number of defects and blemishes permitted varies as the area of the piece to be graded increases or diminishes in respect to the basic size or area specified, but the size of the defects must not exceed that allowed by the grading rules.

21. When defects or blemishes, or combinations thereof, not described in these grading rules are encountered, they will be considered as equivalent to known defects according to their damaging effect upon the piece in the grade under consideration.

22. Equivalent means equal, and in construing and applying these rules, the defects and blemishes allowed, whether specified or not, are understood to be equivalent in damaging effect to those mentioned as applying to the stock under consideration.

23. Imperfections in rough stock which can be removed in dressing to standard sizes shall not be considered in determining the grade under these rules.

24. Defects and blemishes admissible in rough stock shall be the same as those applying to dressed stock of like kind and grade, and in addition, such other defects and blemishes as will disappear in dressing such stock to standard sizes shall be allowed.

25. Material shall be considered edge grain (vertical grain) when the rings (so-called-grain) form an angle of 45° or more with the surface of the piece. When the angle becomes less than 45° at any point, the material shall be known as flat (slash) grain.

26. Mixed grades other than the two highest recognized grades for each species, not specifying the proportion of each grade, are not American Standard grades.

LUMBER SEASONING

27. Specifications dealing with lumber seasoning and moisture content shall be developed by each regional manufacturer's association in accordance with its own conditions and the requirements of the users of its products. Such specifications adopted from time to time by any regional association shall be filed with the Central Committee on Lumber Standards for approval.

2. Yard and Industrial Size Standards

BASIS OF MEASUREMENT OF SIZES

28. The dressed dimensions, specified in paragraphs 30, 31, 32, 33, and 46 and the rough sizes specified in paragraphs 34 to 36, inclusive, shall apply to lumber in the condition of seasoning as sold and shipped.

DRESSED SIZES

29. The terms "standard yard board" and "standard industrial board," and "standard yard dimension" and "standard industrial dimension" shall be the designations for 1-inch boards and 2-inch dimension, respectively.

30. $^{25}/_{32}$ inch, S1S, or S2S, shall be the thickness for the standard yard board; $^{26}/_{32}$ inch, S1S or S2S, for the standard industrial board.

31. $1\frac{5}{8}$ inches, S1S or S2S, shall be the thickness for standard yard dimension not more than 12 inches wide; $1\frac{3}{4}$ inches, S1S, or S2S, for standard industrial dimension.

32. The finished widths of finish S1E or S2E shall be $\frac{3}{8}$ inch off on lumber of standard width of 3 inches; the finished widths of finish S1E or S2E (based on kiln-dried lumber) shall be $\frac{1}{2}$ inch off on lumber of standard widths of 4 to 7 inches, inclusive, and $\frac{3}{4}$ inch off on lumber of standard widths of 8 to 12 inches, inclusive; and the finished widths of boards and dimension S1E or S2E shall be $\frac{3}{8}$ inch off on lumber of standard widths less than 8 inches and $\frac{1}{2}$ inch off on lumber of standard widths of 8 to 12 inches.

33. The thicknesses and widths of finished lumber, S1S or S2S and/or S1E or S2E, shall be as follows:

TABLE 7

FINISH, COMMON BOARDS AND STRIPS, AND DIMENSION AND HEAVY JOIST

[The thicknesses apply to all widths and the widths to all thicknesses]

Product	*Size, Board Measure*		*Dressed Dimensions*		
	Thickness	*Width*	*Standard Thickness, Yard*	*Standard Thickness, Industrial*	*Standard Width*
	Inches	*Inches*	*Inches*	*Inches*	*Inches*
Finish	....	3	$\frac{5}{16}$	....	$2\frac{5}{8}$
	....	4	$\frac{7}{16}$	....	$3\frac{1}{2}$ [a]
	....	5	$\frac{9}{16}$	....	$4\frac{1}{2}$ [a]
	....	6	$\frac{11}{16}$	....	$5\frac{1}{2}$ [a]
	1	7	$^{25}/_{32}$	$^{26}/_{32}$	$6\frac{1}{2}$ [a]
	$1\frac{1}{4}$	8	$1\frac{1}{16}$	....	$7\frac{1}{4}$ [a]
	$1\frac{1}{2}$	9	$1\frac{5}{16}$	....	$8\frac{1}{4}$ [a]
	$1\frac{3}{4}$	10	$1\frac{7}{16}$	....	$9\frac{1}{4}$ [a]
	2	11	$1\frac{5}{8}$	$1^{6}/_{8}$	$10\frac{1}{4}$ [a]
	$2\frac{1}{2}$	12	$2\frac{1}{8}$	....	$11\frac{1}{4}$ [a]
	3	....	$2\frac{5}{8}$	....	....
Common boards and strips	1	3	$^{25}/_{32}$	$^{26}/_{32}$	$2\frac{5}{8}$
	$1\frac{1}{4}$	4	$1\frac{1}{16}$	....	$3\frac{5}{8}$
	$1\frac{1}{2}$	5	$1\frac{5}{16}$	....	$4\frac{5}{8}$
	....	6	....	....	$5\frac{5}{8}$
	....	7	....	....	$6\frac{5}{8}$
	....	8	....	....	$7\frac{1}{2}$
	....	9	....	....	$8\frac{1}{2}$
	....	10	....	....	$9\frac{1}{2}$
	....	11	....	....	$10\frac{1}{2}$
	....	12	....	....	$11\frac{1}{2}$
Dimension and heavy joist	2	2	$1\frac{5}{8}$	$1^{6}/_{8}$	$1\frac{5}{8}$
	$2\frac{1}{2}$	4	$2\frac{1}{8}$	....	$3\frac{5}{8}$
	3	6	$2\frac{5}{8}$	....	$5\frac{5}{8}$
	4	8	$3\frac{5}{8}$	....	$7\frac{1}{2}$
	....	10	....	....	$9\frac{1}{2}$
	....	12	....	....	$11\frac{1}{2}$

[a] Based on kiln-dried lumber.

TABLE 8

SIDING, FLOORING, CEILING, PARTITION, SHIP-LAP, AND DRESSED AND MATCHED

[The thicknesses apply to all widths and the widths to all thicknesses except as modified[1]]

Product	Size, Board Measure		Dressed Dimensions	
	Thickness	Width	Standard Thickness	Standard Face Width
	Inches	Inches	Inches	Inches
Bevel siding	....	4	7/16 by 3/16 [a]	3½
	....	5	10/16 by 3/16	4½
	....	6	....	5½
Wide beveled siding	....	8	7/16 by 3/16 [a]	7¼
	....	10	9/16 by 3/16	9¼
	....	12	11/16 by 3/16	11¼
Rustic and Drop siding (ship-lapped)	....	4	9/16	3⅛
	....	5	¾	4⅛
	....	6	....	5 1/16
	....	8	....	6⅞
Rustic and drop siding (dressed and matched)	....	4	9/16	3¼
	....	5	¾	4¼
	....	6	....	5 3/16
	....	8	....	7
Flooring	....	2	5/16	1½
	....	3	7/16	2⅜
	....	4	9/16	3¼
	1	5	25/32	4¼
	1¼	6	1 1/16	5 3/16
	1½	....	1 5/16	....
Ceiling	....	3	5/16	2⅜
	....	4	7/16	3¼
	....	5	9/16	4¼
	....	6	11/16	5 3/16
Partition	....	3	¾	2⅜
	....	4	....	3¼
	....	5	....	4¼
	....	6	....	5 3/16
Ship-lap	1	4	25/32	3⅛
	....	6	....	5⅛
	....	8	....	7⅛
	....	10	....	9⅛
	....	12	....	11⅛
Dressed and matched	1	4	25/32	3¼
	1¼	6	1 1/16	5¼
	1½	8	1 5/16	7¼
	....	10	....	9¼
	....	12	....	11¼

[1] In tongued-and-grooved flooring and in tongued-and-grooved and ship-lapped ceiling 5/16, 7/16, and 9/16 inch thick, board measure, the tongue or lap shall be 3/16 inch wide, with the over-all widths 3/16 inch wider than the face widths shown above. In all other patterned material, 11/16, ¾, 1, 1¼, and 1½ inches thick, board measure, the tongue shall be ¼ inch wide in tongued-and-grooved lumber, and the lap ⅜ inch wide in ship-lapped lumber, with the over-all widths ¼ inch and ⅜ inch wider, respectively, than the face widths shown above.

[a] Minimum thicknesses.

TABLE 9

FACTORY FLOORING, HEAVY ROOFING, DECKING, AND SHEET PILING

[The thicknesses apply to all widths and the widths to all thicknesses]

Size, Board Measure		*Dressed Dimensions*			
Thickness	*Width*	*Standard Thickness*	*Standard Face Width*		
			D & M	*Ship-lapped*	*Grooved for Splines*
Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
2	4	1⅝	3⅛	3	3½
2½	6	2⅛	5⅛	5	5½
3	8	2⅝	7⅛	7	7½
4	10	3⅝	9⅛	9	9½
....	12	....	11⅛	11	11½

In patterned material 2 inches and thicker, board measure, the tongue shall be ⅜ inch wide in tongued-and-grooved lumber and the lap ½ inch wide in ship-lapped lumber, with the over-all widths ⅜ inch and ½ inch wider, respectively, than the face widths shown above.

ROUGH-DRY SIZES

34. The standard rough dry thickness of the standard yard board shall be not less than $^{29}/_{32}$ inch, with an allowance of 20 per cent of the shipment, which may be not less than $^{28}/_{32}$ inch, and the standard rough dry thickness of the standard industrial board shall be not less than $^{30}/_{32}$ inch, with an allowance of 10 per cent of the shipment, which may be not less than $^{29}/_{32}$ inch.

35. The standard rough dry thickness of finish, common boards, and dimension of standard sizes 1¼ inches and thicker, board measure, shall be not less than ⅛ inch thicker than the corresponding standard finished dry thickness, with an allowance of 20 per cent of the shipment, which may be not less than $^{3}/_{32}$ inch thicker than the corresponding standard finished dry thickness.

36. The standard rough dry width of finish of 3-inch width, board measure, shall be not more than ¼ inch less than the nominal width; the standard rough kiln-dried widths of finish, of widths 4 to 7 inches, inclusive, board measure, shall be not more than ⅜ inch less than the nominal widths, and widths 8 to 12 inches, inclusive, board measure, shall be not more than ⅝ inch less than the nominal widths; and the standard rough dry widths of common boards and dimension, 7 inches and narrower, board measure, shall be not more than ¼ inch less than the nominal widths, and the widths 8 to 12 inches, board measure, shall be not more than ⅜ inch less than the nominal widths.

LENGTHS

37. With the exception of the following enumerated odd lengths, which shall be standard, odd lengths in yard lumber and in structural material shall not be considered in the American Lumber Standards:

2 by 4 inches, 6 and 8 inches—9 and 11 feet.
2 by 8 inches and 10 inches—13 feet.
2 by 10 inches—15 feet.
8 by 8 inches, 10 by 10 inches, 10 by 12 inches, 12 by 12 inches, 14 by 14 inches, 16 by 16 inches, 18 by 18 inches —11 and 13 feet.
6 by 16 inches, 6 by 18 inches, 8 by 16 inches, 8 by 18 inches—15 and 17 feet.

38. The marketing practice covering lengths of yard lumber shall permit the buyer to secure specified lengths and/or specified assortments of lengths.

WORKINGS

39. The standard workings of flooring, ceiling, partition, drop siding and rustic, surfaced two sides and center match, ship-lap, heavy flooring, grooved for splines, and byrkit lath, as shown in Appendix C, shall be considered *standard*. All other workings shall be considered *special*.

40. Unless otherwise stated in the contract of purchase, yard lumber shall be double end-trimmed with a tolerance of not to exceed 3 inches in excess of the nominal length.

MOLDINGS

41. The "standard designs and universal sizes" of wood moldings, as shown in Appendix D, shall be considered *standard*. All other designs and sizes shall be considered *special*.

3. Description, Measurement, and Tally

42. The thicknesses and widths of lumber, as specified in paragraph 33, shall be considered *standard*. All other sizes shall be considered *special*. Lumber of standard size shall be described by those standard dimensions.

43. Lumber of standard size shall be tallied *board measure*. On lumber of standard thickness less than 1 inch (board measure), the board-foot measurement shall be based on the surface dimensions.

44. The board measurement of dressed lumber of standard size shall be based upon the corresponding nominal dimensions of rough green lumber.

45. Lumber finished to special size shall be counted (tallied) as of the standard rough size necessarily used in its manufacture.

46. The measurement and description of the dimensions of lumber shall be as follows:

TABLE 10

Thickness of Lumber Measured and Described as—	*Minimum Thickness, S1S or S2S*
	Inches
1 inch, board measure, to be not less than	25/32
1¼ inches, board measure, to be not less than	1 1/32
1½ inches, board measure, to be not less than	1 9/32
1¾ inches, board measure, to be not less than	1 17/16
2 inches, board measure, to be not less than	1 5/8
2½ inches, board measure, to be not less than	2 1/8
3 inches, board measure, to be not less than	2 5/8
3½ inches, board measure, to be not less than	3 1/8
4 inches, board measure, to be not less than	3 5/8

Widths of finish, measured and described as 3, 4, 5, 6, 7, 8, 9, 10, 11, and 12 inches, board measure, to be, respectively, not less than 2⅝, S1E or S2E, in the condition of seasoning as sold and shipped, and 3½, 4½, 5½, 6½, 7¼, 8¼, 9¼, 10¼, and 11¼ inches, S1E or S2E, based on kiln-dried lumber; widths of boards and dimensions measured and described as 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, and 12 inches, board measure, to be, respectively, not less than 1⅝, 2⅝, 3⅝, 4⅝, 5⅝, 6⅝, 7½, 8½, 9½, 10½ and 11½ inches, S1E or S2E, in the condition of seasoning as sold and shipped.

The description of thickness of dressed stock less than 1 inch, board measure, S1S or S2S, to be its actual thickness in the condition of seasoning as sold and shipped.

Note.—It is to be understood that the standard dimensions of rough lumber are in excess of the dimensions of finished lumber of the corresponding size, board measure, by the amount necessary to permit of surfacing either 1 side or 2 sides and/or 1 edge or 2 edges.

47. Material shipped on stock sizes shall be tallied by the number of pieces of each size and length in the shipment.

48. In shipments measured on board measure a piece tally in board feet shall be made.

49. In material measured with a board rule on actual widths, pieces measuring to the even half foot shall be alternately counted as of the next higher and lower foot count; fractions below the one-half foot shall be dropped and fractions above the one-half foot shall be counted as of the next higher foot.

4. Shipping Provisions

50. The *actual* thickness and width of lumber shipped *when not of standard size* shall be indicated on invoice.

51. In order to encourage the maintenance of standard sizes as agreed to, lumber manufactured and sold as *standard*, if grade marked, shall be marked by an appropriate brand or insignia to indicate that it is of standard size.

52. In shipments of rough finish and boards, pieces one-half inch or more above the count thickness, such as may be produced by uneven sawing, may, at the option of the buyer, be rejected, or accepted as of the next lower grade.

53. The average length of a shipment of lumber shall be computed by dividing the total length in feet by the total number of pieces in a shipment.

54. Each length of bundle stock shall be bundled separately.

5. Grade Marking

55. The principle of grade marking of lumber is approved.

56. On lumber when grade-marked:

(*a*) The grade be marked on lumber of grades equivalent to No. 4 common and better grades, and on lower grades the grade mark be optional.

(*b*) If marked at all, *all* pieces of a given grade be grade-marked (except that unavoidable mechanical skips are, of course, allowed).

(*c*) An easily branded mark or insignia, copyrighted and nationally uniform, be used in connection with the grade mark and be available to identify shipments from all mills of lumber manufactured in accordance with *American Lumber Standards*.

(*d*) An appropriate mark symbolizing *American Lumber Standards* be copyrighted and its use be available to those mills which shall have agreed to maintain the agreed standards of size and grade and to submit their lumber product upon complaint to official association inspection.

6. Tally Cards

57. Cards be placed in cars of lumber at mill of origin, showing piece tally by grades and sizes: *Provided*, That wholesale dealer, or other buyer or shipper, may, by arrangement with mill of origin, provide for use, for this purpose, of wholesaler's or buyer's or shipper's car card: *Provided*, That in such case said wholesaler, buyer, or shipper whose name appears on card is financially responsible for the correctness of the tally as shown on such car card: *And provided*, That this shall not be construed as relieving the manufacturer from his responsibility, if any, to such wholesaler, buyer, or shipper.

58. The grades thus required to be entered on tally card be the official association grades as defined in published grading rules: *Provided*, That this requirement is not construed as prohibiting the entry on tally cards of special grades, but that such entry is not recognized under *American Lumber Standards*.

59. The *American Lumber Standards* be understood as not applying to "special" grades (that is, not recognized in published grading rules) whether entered on tally cards or not.

7. Shingles

grades

60. The basic grades of shingles shall be A, B, C, and D. The grade name shall be clearly marked on each and every bundle of wood shingles.

sizes

61. 16-inch 6/2 shingles and 18-inch 5/2 shingles shall be eliminated.

62. Dimension shingles shall be sold full net count, no dimension shingle to be less than $\frac{1}{8}$ inch scant of the specified width when dried.

shipping provisions

63. The kiln-dried weight of shingles shall be not more than 10 per cent under the present association shipping weights.

64. The openings shall not exceed an average of 1 inch to the course in random-width shingles.

SPECIFICATIONS FOR RED CEDAR SHINGLES

65. The specifications of 24, 18, and 16 inch red cedar shingles shall be as shown in Appendix E.

IV. Structural Material

Basic Provisions for the Selection and Inspection of Softwood Dimension and Timbers where Working Stresses are Required.

The following provisions are for use as a basis for the preparation by lumber manufacturers of grading rules for structural material. It is understood that these basic provisions are not to be used as grading rules, but are merely a standardized working basis to enable manufacturers of the various species to coördinate their grades as far as possible.

1. Basic Grade and Use Classifications

66. Basic grade classification: (*a*) *Dense select.*—Douglas fir and southern pine; (*b*) *Select.*—Douglas fir; (*c*) *Select.*—Other softwood species except southern pine; (*d*) *Dense common.*—Douglas fir and southern pine; and (*e*) *Common.*—All softwood species.

67. Use classifications: (*a*) *Joist and plank.*—Joists, rafters, plank, factory flooring, etc.; (*b*) *Beams and stringers.*—Beams, girders, stringers, etc.; and (*c*) *Post and timbers.*—Posts, caps, sills, other timbers, etc.

2. Optional Provisions

68. No heartwood requirements are provided in these grades. Heartwood when desired, for durability of untreated timber, should be specified in terms of heartwood required on the girth, or on each face, side, or edge. Girth shall be measured at the point where the greatest amount of sapwood occurs.

69. For material to be treated, a large amount of sapwood is to be preferred. It is not practicable to specify a minimum sapwood requirement, but it could be provided that there is no restriction on sapwood.

70. Wane is permissible in all grades, as far as strength properties are concerned, but square edges may be specified when appearance, bearing, or other factors of use require.

3. General Provisions

SOUND WOOD

71. All grades shall contain only sound wood, free from any form of decay, incipient or advanced, including firm red heart, dote, and rot.

DEFINITIONS OF FACES AND EDGES

72. The faces of a piece of dimension or of a timber are the four longitudinal surfaces of the piece, sometimes further designated as "wide" faces or "narrow" faces.

73. In a piece of dimension or of a timber graded for use in bending, wide faces shall be taken as vertical faces, and narrow faces as horizontal faces, unless otherwise noted.

74. When the faces of a piece of dimension or of a timber are of equal width, post and timber grades shall be used unless otherwise noted. When such a piece of dimension or such a timber is graded for use in bending, the best faces shall be taken as the horizontal faces and should be so marked.

75. The edges of a piece of dimension or of a timber are understood to be the narrower faces, and the sides the wider faces. In describing the locations of knots and other defects in structural material, however, the edges of a given face are understood to be the intersection of two adjacent faces, commonly called corners in the past.

KNOTS

76. The size of a knot shall be measured on the section of the knot appearing on the face under consideration.

77. On narrow faces of joist and plank, and on narrow or horizontal faces of beams and stringers, the size of a knot shall be taken as its width between lines parallel to the edges of the piece.

78. On wide or vertical faces of beams and stringers, the smallest diameter of a knot shall be taken as its size.

79. Knots at edges of wide or vertical faces of beams and stringers are limited to the same size as on adjacent narrow or horizontal faces, but the size is measured on the least diameter of the knot instead of on its width between lines parallel to the edges of the piece.

80. In posts and timbers, and on wide faces of joist and plank, the size of a knot shall be measured on the mean or average diameter. The mean or average diameter of a knot shall be taken as the average of the maximum and minimum diameters.

81. The size of knots on narrow faces and at edges of wide faces of joist and plank, and on narrow or horizontal faces and at edges of wide or vertical faces of beams and stringers, may increase proportionately from the size allowed in the middle third to twice that size at the ends of the piece.

82. The size of knots on wide faces of joist and plank, and on wide or vertical faces of beams and stringers, may increase proportionately from the size allowed at the edge to that allowed at the center line.

83. Cluster knots and knots in groups are not permitted.

84. Knot holes and holes from other causes than knots shall be limited as provided for knots.

SHAKES AND CHECKS

85. Shake shall be measured on the ends of a piece.

86. In joist and plank, and in beams and stringers, the size of a shake shall be taken as the shortest distance between lines inclosing the shake and parallel to the wide faces of the piece.

87. In posts and timbers, the size of a shake shall be measured between lines parallel to each pair of opposite faces, and the greater of these two distances shall be taken as its size.

88. Checks and splits shall be limited as provided for shakes. No checks or combinations of checks with shakes which would reduce the strength to a greater extent than the allowable shake shall be permitted.

PITCH POCKETS

89. Pitch pockets ordinarily are not defects in a structural grade. A large number in a piece, however, indicates a general lack of bond, and such a piece should be carefully examined for shakes.

SLOPE OF GRAIN

90. Slope of grain shall be measured over a distance which will assure the determination of the general slope of the grain not influenced by short, local deviations. In a piece in bending, slope of grain is of greatest importance on the top and bottom faces. If meeting the limitation of a grade in these locations, it may be somewhat greater elsewhere.

WANE

91. Where wane is permitted, there shall be no combination of wane and knots which would reduce the strength more than the maximum allowable knot.

WEIGHT

92. No pieces of exceptionally light weight shall be permitted in any grade.

BASIS OF MEASUREMENT OF SIZES

93. The dressed dimensions specified in paragraphs 114, 122, and 129 shall be minimum dimensions when measured green.

4. Density and Close Grain

94. Methods of measurement of Douglas fir and southern pine for density are given for use with the dense grades. Methods of measurement for rate of growth shall be given for use in the case of species and grades where close grain is required.

DENSE DOUGLAS FIR

95. Douglas fir of dense material shall average on either one end or the other not less than six annual rings per inch, and, in addition, one-third or more summer wood, the darker, harder portion of the annual ring, measured over a 3-inch portion of a radial line located as described below. The contrast in color between summer wood and spring wood shall be distinct.

96. Coarse-grained material excluded by this rule shall be accepted as dense if averaging one-half or more summer wood.

97. In inspection for density, reasonable variation of opinion between inspectors must be recognized. In reinspection of a particular lot of timbers for density, for every three timbers accepted as having one-third or more summer wood, one of the remaining timbers shall be accepted if agreed upon as having between 30 and 33⅓ per cent summer wood.

CLOSE-GRAINED DOUGLAS FIR

98. Douglas fir of close grain shall average on either one end or the other not less than 6 nor more than 20 annual rings per inch, measured over a 3-inch portion of a radial line located as described below.

99. Pieces averaging from five to six annual rings per inch shall be accepted as equivalent of close grain if having one-third or more summer wood.

LOCATION OF RADIAL LINE IN DOUGLAS FIR

100. The radial line shall be representative of the average growth on the cross-section.

101. When the radial line specified is not representative, it shall be shifted sufficiently to present a fair average, but the distance from the pith to the beginning of the 3-inch portion of the line in boxed heart pieces shall not be changed.

102. In case of disagreement two radial lines shall be chosen, and the number of rings per inch or percentage of summer wood shall be taken as the average determined on these lines.

103. In boxed heart pieces the radial line shall run from the pith to the corner farthest from the pith. When the least dimension is 6 inches or less, the 3-inch portion of the line shall begin at a distance of 1 inch from the pith. When the least dimension is more than 6 inches, the 3-inch portion of the line shall begin at a distance from the pith equal to 2 inches less than one-half the least dimension of the piece.

104. In side-cut pieces the radial line shall be at a right angle to the annual rings and the center of the 3-inch portion of the line shall be at the center of the end of the piece.

105. If a 3-inch portion of a radial line cannot be obtained, the measurement shall be made over as much of a 3-inch portion as is available.

DENSE SOUTHERN PINE

106. Southern pine of dense material shall average on either one end or the other not less than six annual rings per inch, and, in addition, one-third or more summer wood, the darker, harder portion of the annual ring, measured over the third, fourth, and fifth inches of a radial line from the pith. The contrast in color between summer wood and spring wood shall be sharp and the summer wood shall be dark in color, except in pieces having considerably above the minimum requirement for summer wood.

107. Coarse-grained material excluded by this rule shall be accepted as dense if averaging one-half or more summer wood.

108. In inspection for density, reasonable variation of opinion between inspectors must be recognized. In reinspection of a particular lot of timbers for density, for every three timbers accepted as having one-third or more summer wood, one of the remaining timbers shall be accepted if agreed upon as having between 30 and 33⅓ per cent of summer wood.

LOCATION OF RADIAL LINE IN SOUTHERN PINE

109. The radial line shall be representative of the average growth on the cross section.

110. In case of disagreement, two radial lines shall be chosen, and the number of rings per inch and percentage of summer wood shall be taken as the average determined on these lines.

111. In boxed heart pieces the measurement shall be made over the third, fourth, and fifth inches from the pith along the radial line.

112. In material containing the pith, but not a 5-inch radial line, which is less than 2 by 8 inches in section or less than 8 inches in width, that does not show over 16 square inches on the cross-section, the inspection shall apply to the second inch from the pith. In larger material that does not show a 5-inch radial line, the inspection shall apply to the 3 inches farthest from the pith.

113. In cases where timbers do not contain the pith and it is impossible to locate it with any degree of accuracy, the same inspection shall be made over 3 inches on an approximate radial line beginning at the edge nearest the pith in timbers over 3 inches in thickness and on the second inch nearest the pith in timbers 3 inches or less in thickness.

5. Joist and Plank

JOISTS, RAFTERS, PLANK, FACTORY FLOORING, ETC.

114. Nominal thicknesses: 2 to 4 inches.
Nominal widths: 4 inches and wider.
Standard thicknesses, S1S or S2S: 3/8 inch off.
Standard widths, 4 to 7 inches, S1E or S2E: 3/8 inch off: 8 inches and wider, S1E, or S2E: 1/2 inch off.
Standard lengths: Multiples of 2 feet.

TABLE 11

115. KNOTS ON WIDE FACES

Dense Select and Select			*Dense Common and Common*	
At Edge of Wide Face Middle Third of Length	*On Center Line of Wide Face*	*Width of Face in Inches*	*At Edge of Wide Face Middle Third of Length*	*On Center Line of Wide Face*
Inches	*Inches*		*Inche*	*Inches*
3/4	1 1/4	4	1	1 3/4
1	2	6	1 1/2	2 1/2
1 3/8	2 5/8	8	2	3 3/8
1 3/4	3 1/4	10	2 1/2	4 1/4
2 1/8	4	12	3	5 1/8
2 3/8	4 1/4	14	3 1/4	5 5/8
2 1/2	4 5/8	16	3 3/8	6

TABLE 12

116. KNOTS ON NARROW FACES OF BOXED HEART PIECES, MIDDLE THIRD OF LENGTH

Dense Select and Select	*Thickness of Piece in Inches*	*Dense Common and Common*
Inches		*Inches*
5/8	2	7/8
1	3	1 1/4
1 1/4	4	1 3/4

117. SUM OF DIAMETERS OF KNOTS ON ANY FACE, CENTER HALF OF LENGTH, NOT TO EXCEED

Dense Select and Select
One and one-half times width of face.

Dense Common and Common
Two times width of face

118. Shakes and Checks

Dense Select and Select		*Dense Common and Common*
¼ width of end	green	$^4/_{10}$ width of end
⅓ width of end	seasoned	$^4/_9$ width of end

119. Slope of Grain, Center Half of Length

Dense Select and Select	*Dense Common and Common*
1 in 12	1 in 10

120. Wane

Dense Select and Select	*Dense Common and Common*
⅛ width of any face	¼ width of any face

121. Douglas fir or southern pine of dense grades shall be selected for density. Douglas fir of select grade shall be selected for close grain.

6. Beams and Stringers

BEAMS, GIRDERS, STRINGERS, ETC.

122. Nominal thicknesses: 5 inches and thicker.
Nominal widths: 8 inches and wider.
Standard sizes: S1S, S1E, S2S, or S4S: ½ inch off each way.
Standard lengths: Multiples of 2 feet.

TABLE 13

123. Knots

Dense Select and Select		*Width of Face in Inches*	*Dense Common and Common*	
On Narrow or Horizontal Face, Middle Third of Length	*On Center Line of Wide or Vertical Face*		*On Narrow or Horizontal Face, Middle Third of Length*	*On Center Line of Wide or Vertical Face*
Inches	*Inches*		*Inches*	*Inches*
1¼	1¼	5	2	2
1½	1½	6	2⅜	2⅜
1¾	2	8	2¾	3⅛
2	2½	10	3⅛	4
2⅛	3	12	3⅜	4¾
2¼	3¼	14	3⅝	5⅛
2⅜	3⅜	16	3⅞	5½
....	3⅝	18	....	5⅞
....	3⅞	20	....	6⅛
....	4	22	....	6½
....	4¼	24	....	6¾

124. Sum of Diameters of Knots on Any Face, Center Half of Length, not to Exceed

Dense Select and Select	*Dense Common and Common*
Width of face	1½ times width of face

125. Shakes and Checks

Dense Select and Select		*Dense Common and Common*
¼ width of end	green	$^4/_{10}$ width of end
⅓ width of end	seasoned	$^4/_9$ width of end

126. Slope of Grain, Center Half of Length

Dense Select and Select	*Dense Common and Common*
1 in 15	1 in 10

127. Wane

Dense Select and Select	*Dense Common and Common*
1/8 width of any face	1/4 width of any face

128. Douglas fir or southern pine of dense grades shall be selected for density. Douglas fir of select grade shall be selected for close grain.

7. Posts and Timbers

posts, caps, sills, other timbers, etc.

129. Nominal sizes: 6 by 6 inches and larger.
Standard sizes: S1S, S1E, S2S, or S4S: 1/2 inch off each way.
Standard lengths: Multiples of 2 feet.

TABLE 14

130. Knots [1]

Dense Select and Select	*Width of Face in Inches*	*Dense Common and Common*
Inches		*Inches*
1 1/2	6	2 3/8
2	8	3 1/8
2 1/2	10	4
3	12	4 3/4
3 1/4	14	5 1/8
3 3/8	16	5 1/2
3 5/8	18	5 7/8
3 7/8	20	6 1/8
4	22	6 1/2
4 1/4	24	6 3/4

131. Sum of Diameters of All Knots within any 6 Inches of Length, not to Exceed

Dense Select and Select — *Dense Common and Common*

Twice size of maximum knot allowable; nor to be two of maximum allowable knots in same 6 inches of length on any one face.

132. Shakes and Checks

Dense Select and Select		*Dense Common and Common*
4/10 width of end	green	1/2 width of end
1/2 width of end	seasoned	6/10 width of end

133. Slope of Grain

Dense Select and Select	*Dense Common and Common*
1 in 10	1 in 8

134. Wane

Dense Select and Select	*Dense Common and Common*
1/8 width of any face	1/4 width of any face

135. Douglas fir or southern pine of dense grades shall be selected for density. Douglas fir of select grade shall be selected for close grain.

V. Softwood Factory and Shop Lumber

1. General Provisions

136. The grade of factory and shop lumber shall be determined by the percentage of the area of each board or plank available in cuttings of specified, or given minimum, sizes and qualities, except in the upper grades of shop lumber of all thicknesses.

[1] On faces less than 6 inches in width, knots shall not exceed: in Dense Select and Select, 1/4 width of face. In Dense Common and Common, 4/10 width of face.

137. The grade of softwood factory boards or plank, and shop lumber, shall be determined from the poor face, although the quality of both sides of each cutting must be considered.

138. When lumber is crooked, bowed, cupped, or twisted, the cuttings must be so laid out as to be flat and straight along the edges.

139. Board measurement shall be used in measuring factory and shop lumber. When measured with a board rule, pieces measuring to the even half foot shall be alternately counted as of the next higher and the next lower surface foot; fractions below the half foot shall be dropped, and fractions above the half foot shall be counted as of the next higher foot. To determine the board-foot contents of material thicker than 1 inch, the surface measure should be multiplied by the nominal thickness in inches and fractions of an inch.

140. The board measurement of dressed factory and shop lumber of standard size shall be based upon the corresponding standard dimensions of rough green lumber.

LUMBER SEASONING

141. Specifications dealing with lumber seasoning and moisture content shall be developed by each regional manufacturer's association in accordance with its own conditions and the requirements of the users of its products. Such specifications adopted from time to time by any regional association shall be filed with the Central Committee on Lumber Standards for approval.

2. Size Standards

BASIS OF MEASUREMENT OF SIZES

142. The dressed dimensions specified in paragraph 143 shall apply to lumber in the condition of seasoning as sold and shipped.

DRESSED THICKNESSES

143. The following thicknesses of factory and shop lumber shall be considered *standard.* All other thicknesses shall be considered *special.*

TABLE 15

Size, Board Measure in Inches	*Standard Finished Thicknesses, S1S or S2S*
	Inches
1	$^{25}/_{32}$ and $^{26}/_{32}$
1¼	1$^{5}/_{32}$
1½	1$^{13}/_{32}$
2	1$^{26}/_{32}$
2¼	2⅛
2½	2⅜
3	2$^{6}/_{8}$
4	3$^{6}/_{8}$

NOTE.—It is to be understood that any association which publishes and administers rules for factory and shop lumber under the American Lumber Standards, will not be required to furnish 1-inch factory lumber in both finished thicknesses.

WIDTHS

144. Standard widths shall be 5 inches and over; factory and shop lumber is usually shipped in random widths, though specified widths may be shipped. Five-inch widths must be full size in the rough-dry condition.

LENGTHS

145. Standard lengths shall be 6 feet and over in multiples of 1 foot, except in box lumber which shall be 4 feet and over.

3. Factory Plank

146. In determining the percentage of door cuttings, consideration must be given to the fact that planks are to be ripped full length before crosscutting, in such manner as will yield the highest grade and largest percentage of door cuttings, except in such cases where planks will yield a higher value by first being crosscut for rails. In instances where stock is crosscut for rails and some of the stock so obtained contains stiles or muntins or top rails, which can be obtained by ripping this crosscut stock, the door cuttings so obtained may be figured in when determining percentages.

147. TABLE 16

Basic Grade Classifications for Softwood Factory Plank

Factory Plank Factory lumber graded with reference to its use for doors, sash, and other cuttings.	*Factory Clears* Upper grades of factory plank containing a high percentage of best-quality cuttings.	*Nos. 1 and 2 clear factory*—Lumber, practically clear in wide sizes, to contain not less than 85 per cent of No. 1 door cuttings, not including pieces with over two muntins, or muntins only	
		No. 3 clear factory—Lumber containing not less than 70 per cent of No. 1 door cuttings, not including pieces with over two muntins, or muntins only	
	Shop Lower grades of factory plank yielding smaller percentages in smaller and lower quality cuttings.	*No. 1 shop*—Lumber of high quality factory grade containing not less than 50 per cent of No. 1 door cuttings allowing, if necessary, one No. 2 stile in any piece, but no pieces with over two muntins, or muntins only	
		No. 2 shop—Lumber containing not less than 25 per cent of No. 1 door cuttings, or 40 per cent No. 2 door cuttings, or 33⅓ per cent of mixed door cuttings	
		No. 3 shop—Lumber of a shop type below the grade of No. 2 shop and better than box lumber	

Quality of Cuttings

148. In determining the grades of factory plank two grades of cuttings shall be recognized. These shall be known as No. 1 and No. 2 cuttings and shall conform to the following rules.

149. *No. 1 cuttings* shall be free from defects on both sides. No restrictions shall be made upon bright sapwood.

150. *No. 2 cuttings* shall admit any one of the following defects:

Light blue stain on one side, not larger in extent than one-half the area of the side.

Medium brown kiln or heart stain covering half the surface on one face, or a greater area of lighter stain, or a proportionate amount on two sides.

A small sound and tight knot which does not exceed five-eighths of an inch in diameter.

A small pitch pocket not over one-eighth of an inch wide nor over 2 inches long in west coast woods and not over one-eighth of an inch wide nor over 1 inch long in western pine and California pine.

One or more small season checks whose combined length does not exceed 8 inches.

Light pitch or small pitch streaks that do not form a pronounced defect.

Slightly torn grain one one side.

Sizes of Cuttings

151. *Stiles* shall be 5 and 6 inches wide by 6 feet 8 inches to 7 feet 6 inches long. They may be either No. 1 or No. 2 in quality.

152. *Bottom rails* shall be 9 and 10 inches wide by 2 feet 4 inches to 3 feet long. They may be either No. 1 or No. 2 in quality.

153. *Muntins* shall be 5 and 6 inches wide by 3 feet 6 inches to 4 feet long. They may be either No. 1 or No. 2 in quality.

154. *Top rails* shall be 5 and 6 inches wide by 2 feet 4 inches to 3 feet long. They must be of No. 1 cutting quality, but shall be considered as No. 2 cuttings.

155. *Sash cuttings* shall be 2½ and 3½ inches in width by 28 inches and over in length.

156. In computing the area of cuttings in each piece of factory plank the sizes listed below shall be used. After each cutting size is shown the exact surface area in square feet. For convenience in computing, the figures shown on the right, representing the area to the nearest one-fourth square foot, shall be used.

TABLE 17

STILES

Size of Cutting in	*Actual Area in Square Feet*	*Nominal Area to be Used in Application of Grading Rules*
BOARD OR PLANK		
5 inches by 6 feet 8 inches	2.78	3
5 inches by 6 feet 10 inches	2.85	
5 inches by 7 feet	2.92	
5 inches by 7 feet 2 inches	2.99	
5 inches by 7 feet 4 inches	3.06	
5 inches by 7 feet 6 inches	3.13	
6 inches by 6 feet 8 inches	3.33	3¼
6 inches by 6 feet 10 inches	3.42	3½
6 inches by 7 feet	3.50	
6 inches by 7 feet 2 inches	3.58	
6 inches by 7 feet 4 inches	3.67	3¾
6 inches by 7 feet 6 inches	3.75	
BOTTOM RAILS		
9 inches by 2 feet 4 inches	1.75	1¾
9 inches by 2 feet 6 inches	1.875	
9 inches by 2 feet 8 inches	2.0	2
9 inches by 2 feet 10 inches	2.125	
9 inches by 3 feet	2.25	2¼
10 inches by 2 feet 4 inches	1.94	2
10 inches by 2 feet 6 inches	2.08	
10 inches by 2 feet 8 inches	2.22	2¼
10 inches by 2 feet 10 inches	2.36	
10 inches by 3 feet	2.50	2½
MUNTINS		
5 inches by 3 feet 6 inches	1.46	1½
5 inches by 3 feet 8 inches	1.53	
5 inches by 3 feet 10 inches	1.60	
5 inches by 4 feet	1.67	1¾
6 inches by 3 feet 6 inches	1.75	
6 inches by 3 feet 8 inches	1.83	
6 inches by 3 feet 10 inches	1.92	2
6 inches by 4 feet	2.0	
TOP RAILS		
5 inches by 2 feet 4 inches	0.97	1
5 inches by 2 feet 6 inches	1.04	
5 inches by 2 feet 8 inches	1.11	
5 inches by 2 feet 10 inches	1.18	
5 inches by 3 feet	1.25	
6 inches by 2 feet 4 inches	1.17	1¼
6 inches by 2 feet 6 inches	1.25	
6 inches by 2 feet 8 inches	1.33	
6 inches by 2 feet 10 inches	1.42	1½
6 inches by 3 feet	1.50	

4. Shop Lumber

TABLE 18

157. Basic Grade Classifications for Softwood Shop Lumber

Shop Lumber	*For Shop Lumber 1 Inch in Thickness*[1]	*For Shop Lumber of all Thicknesses*[2]
Shop lumber graded for cuttings of minimum and larger sizes, or for permissible defects, with reference to its use for general cut-up purposes	Select Lumber to contain not less than 70 per cent of (*a*) and/or (*b*) cuttings Shop Lumber to contain not less than 50 per cent of (*a*) and/or (*b*) cuttings	*Tank and boat stock.*—Lumber admitting sound defects that do not impair the usefulness of each piece for the use intended *Firsts and seconds.*—Lumber of C select or better quality on the reverse side, suitable for remanufacture into products requiring both faces of good quality *Selects.*—Lumber of C select or better quality on the face side suitable for remanufacture into products requiring one face of good quality *No. 1 shop.*—Lumber to contain not less than 60 per cent of (*a*) and/or (*b*) cuttings *No. 2 shop.*—Lumber to contain not less than 40 per cent of (*a*) and/or (*b*) cuttings *Box.*—Lumber below the grade of No. 2 shop to contain not less than 66⅔ per cent sound cuttings not less than 3 inches wide and 18 inches long

158. In determining the grades of either shop or cut-up lumber based on cuttings, two grades and sizes of cuttings shall be recognized and shall conform to the following rules:

SIZES OF CUTTINGS

159. (*a*) *Cuttings* shall be 9½ inches wide or wider by 18 inches long or longer.

160. (*b*) *Cuttings* shall be 5 inches wide or wider by 3 feet long or longer.

QUALITY OF CUTTINGS

161. (*a*) *Cuttings* less than 3 feet long shall be free from all defects on both sides. No restriction need be made upon bright sapwood.

162. (*a*) *Cuttings* 3 feet long or longer and (*b*) *cuttings* shall have a C select or better face in all softwoods except Douglas fir, Sitka spruce, and West Coast hemlock, where the face of the cuttings shall be equal to B or better finish.

VI. Lumber Inspection Provisions and Service

163. Lumber must be accepted on grade in the form in which it is shipped. Any subsequent change in manufacture, millwork, or dry-kilning will prohibit an inspection for the adjustment of claims, except with the consent of all parties interested.

164. Official association inspection service for the inspecting of lumber sold as of standard size and standard grade shall be available to nonmembers of associations upon request and at a reasonable charge.

165. In case of complaint on account of the grade or tally of any shipment of standard size or standard grade, official association reinspection shall be available.

166. Official association inspection service shall not be required to be furnished for the inspection of "special" grades of lumber (that is, not recognized in published grading rules), and inspection service for "special" grades shall be furnished only when the exact specifications of such grades in writing are furnished to the inspector.

[1] For northern, western, and California pine, and west coast woods.

[2] For cypress, redwood, and North Carolina pine.

167. Where buyers demand, and will pay the cost thereof, a certificate made by a certified association inspector shall be furnished with each shipment so arranged for.

168. Upon receipt of complaint from the purchaser the seller shall immediately request the association under whose rules shipment has been made to provide official reinspection or retally, as the case may be, according to its inspection rules in effect at the time of execution of contract; and the purchaser shall lend all reasonable assistance to facilitate the reinspection or retally.

169. The expense of such reinspection or retally may be divided between the buyer and seller, or may be borne by either, according to agreement between them, but the person calling for the reinspection shall be responsible to the association for the costs thereof.

170. In case of complaint involving tally, the entire item shall be held intact for retally.

171. In cases of complaint regarding grade but not involving tally, the buyer is required to accept that portion of a shipment of lumber of standard grade or standard size which is up to grade or of standard size as the case may be, holding intact that portion thereof the grade or size of which is in dispute for official association inspection; the action on the part of the buyer in accepting and using such portion of the shipment shall not be construed as his acceptance of the entire shipment; further, the buyer shall pay in accordance with the terms of sale for that portion which he accepts, but acceptance by the buyer of a part of a shipment does not prejudice his just claims on account of any unused material that is alleged by him to be below standard grade or not of standard size. The complainant buyer shall hold disputed material intact, properly protected, for not exceeding 30 days after date of the request for official inspection or reinspection, and shall file complaint with seller within 10 days from receipt of shipment.

172. Each item in a carload or cargo shall be considered as of the grade invoiced if, upon official association reinspection under the grading and inspection rules under which the lumber has been graded and sold, 95 per cent thereof or more is found to be of said grade, the material below said grade to be accepted by the buyer as of its actual grade. Where the degrades are in excess of 5 per cent of such item, or where the degrades are found upon official reinspection to be more than one grade lower than the grade invoiced, the degrades shall be the property of the seller. These provisions shall not apply in the case of specially worked lumber.

173. There shall be created by the lumber manufacturers a central bureau to promote uniformity and the maintenance of high standards of grading and inspection of lumber.

174. Each manufacturers' association publishing lumber grading rules and conducting inspection service shall furnish to such central bureau complete information descriptive of the plan of operation and continuous regular reports of its inspection department.

175. In order to simplify, coördinate, and, so far as practicable, unify the methods of inspection, each such association shall be furnished by such central bureau the plan of operation and the record of performance of the inspection service of each other association.

176. In pursuance of national responsibility of the lumber industry for the maintenance of agreed American Lumber Standards, if, after original association inspection, reinspection, and if necessary after reinspection, a report thereon of the chief inspector, any complaint involving agreed and published standards of lumber size, or grade, or inspection shall not have been settled, the National Lumber Manufacturers Association, by agreement or upon request, will represent the manufacturing shipper in arrangement for arbitration.

177. The National Lumber Manufacturers Association will represent, by agreement, the subscribing regional associations of lumber manufacturers, and other associations of, or representing, lumber manufacturers, upon request, in matters involving the administration of inspection and the maintenance of the agreed standards of lumber size and lumber grade designated as American Lumber Standards.

178. The formulation of regulations for the conduct of inspection to secure the application of the grading rules published by lumber associations, and the administration, supervision, and conduct of inspection service, be exclusively by the lumber industry, and/or lumber consumers (that is, by the lumber trade, and/or lumber consumers, and not by or under the authority, auspices, or direction of any Government agency or agencies).

179. Nationally administered association lumber inspection, in the sense of a national service to replace the existing services of regional and other associations, is not now practicable.

180. Each association shall undertake to reinspect lumber for its members and for nonmembers upon request.

181. All grading shall be done by properly supervised and qualified graders or inspectors.

182. So far as it is within their power, the associations within the lumber industry shall undertake, through association grades and inspection service, arbitration, and, if practicable, through grade marking and otherwise, to maintain for the benefit of the lumber-using public the standards of size and basic grade names and classifications as agreed upon and as published in the association grading and inspection rules.

183. The associations which make grading rules and conduct lumber inspection service shall maintain such size, grade, and inspection standards as may have been agreed to.

184. Each such association shall assume responsibility for the maintenance in the manner herein outlined, by its individual members or subscribers, of said size standards, basic grade classifications, and inspection standards.

185. The principle of responsibility of the entire organized lumber industry for the maintenance of agreed and published size, grade, and inspection standards is recognized; and for the suitable discharge of such responsibility the Central Committee on Lumber Standards or similar suitable agency shall be continued.

186. Lumber manufactured, graded, measured, and described, as herein provided, shall be considered American Standard lumber. The purchase, sale, or shipment of lumber as American Standard is construed as involving agreement to submit to official association inspection any complaint involving either standard sizes or standard grades.

187. Sales contracts should incorporate in substance the following clause:

> Shipment under this contract shall be in accordance with the American Lumber Standards.

In the case of shipments made or received under such contracts exemption from any provision of the American Lumber Standards shall be by special agreement and the burden of proof thereof shall be upon person claiming exemption.

VII. General

Lumber Abbreviations

188. The *standard lumber abbreviations*, as shown in Appendix F when used in contracts and other documents arising in the transactions of purchase and sale of American Standard lumber shall be construed as therein provided.

Appendix A.—Nomenclature of Commercial Softwoods

The following standard commercial names for lumber cut from the principal species of softwoods shall be used in the formation of lumber-grading rules and in the construction of contracts and the terms of purchase and sale of American Standard lumber. Preferred commercial names are shown in italic.

TABLE 19

Standard Commercial Name	*Botanical Name*
CEDARS AND JUNIPERS	
Alaska cedar	Chamæcyparis nootkatensis
Eastern red cedar	Juniperus virginiana, Juniperus lucayana (southern red cedar), and Juniperus mexicana (mountain juniper)
Incense cedar	Libocedrus decurrens
Northern white cedar	Thuja occidentalis
Port Orford cedar	Chamæcyparis lawsoniana
Southern white cedar	Chamæcyparis thyoides
Western juniper	Juniperus utahensis (Utah juniper), Juniperus pachypholœa (alligator juniper), Juniperus scopulorum (Rocky Mountain red cedar), and Juniperus occidentalis (western juniper)
Western red cedar	Thuja plicata

TABLE 19—*Continued*

Standard Commercial Name	*Botanicial Name*
CYPRESS	
Red cypress (coast type)	Taxodium distichum
Yellow cypress (inland type)	Taxodium distichum
White cypress (inland type)	Taxodium distichum
DOUGLAS FIR	
Douglas fir (coast type)	Pseudotsuga taxifolia
Red fir (intermountain type)	Pseudotsuga taxifolia
Red fir (Rocky Mountain type)	Pseudotsuga taxifolia
THE TRUE FIRS	
Alpine fir	Abies lasiocarpa
Balsam fir	Abies balsamea and Abies fraseri (southern balsam fir)
Golden fir	Abies magnifica
Noble fir	Abies nobilis
Silver fir	Abies amabilis
White fir	Abies concolor and Abies grandis (lowland white fir)
HEMLOCKS	
Eastern hemlock	Tsuga canadensis, and Tsuga caroliniana (Carolina hemlock)
Mountain hemlock	Tsuga mertensiana
West coast hemlock	Tsuga heterophylla
LARCH (SEE ALSO TAMARACK)	
Western larch	Larix occidentalis
PINES	
Arkansas soft pine	Pinus echinata and tæda
California white pine	Pinus ponderosa and Pinus jeffreyi (Jeffrey pine)
Idaho white pine	Pinus monticola
Jack pine	Pinus banksiana
Loblolly pine	Pinus tæda
Lodgepole pine	Pinus contorta
Longleaf pine	Pinus palustris
North Carolina pine	Pinus tæda and echinata, and Pinus virginiana (Virginia pine)
Northern white pine	Pinus strobus
Norway pine	Pinus resinosa
Pond pine	Pinus rigida serotina
Pondosa pine	Pinus ponderosa
Shortleaf pine	Pinus echinata
Slash pine	Pinus caribæa
Southern pine	Pinus tæda, palustris, serotina, echinata, and caribæa, and Pinus rigida (pitch pine), and Pinus glabra (spruce pine)
Sugar pine	Pinus lambertiana
REDWOOD	
Redwood	Sequoia sempervirens
SPRUCES	
Eastern spruce	Picea mariana (black spruce), Picea rubra (red spruce), and Picea glauca (white spruce)
Englemann spruce	Picea engelmanni and Picea parryana (blue spruce)
Sitka spruce	Picea sitchensis
TAMARACK	
Tamarack	Larix laricina
YEW	
Pacific yew	Taxus brevifolia

Appendix B.—Definitions of Maximum Defects and Blemishes

A *defect* is defined as any irregularity occurring in or on wood that may lower some of its strength, durability, or utility values.

A *blemish* is defined as anything, not classified as a defect, marring the appearance of the wood.

The commonly recognized defects and blemishes occurring in (names of species manufactured) yard lumber are:

Bark pockets
Bird's-eye
Checks
Cross breaks
Cross grain
Decay
Gum spots and streaks
Holes
Imperfect manufacture
Knots
Pitch
Pitch pockets
Pitch seams
Pitch streaks
Pith
Pith flecks
Shake
Splits
Stain or discoloration
Wane
Warp

BARK POCKETS

A *bark pocket* is a patch of bark partially or wholly inclosed in the wood. In size it is classified the same as pitch pockets.

BIRD'S-EYE

"*Bird's-eye*" is a small central spot with the wood fibers arranged around it in the form of an ellipse, so as to give the appearance of an eye. "Bird's-eye," unless unsound or hollow, shall not be considered a defect.

CHECKS

A *check* is a lengthwise separation of the wood, which occurs usually across the rings of annual growth.

A *surface check* is a check occurring on the surface of a piece.

A *small surface check* is a perceptible opening not over 4 inches long.

A *medium surface check* is one not over $\frac{1}{32}$ inch wide and over 4 but not more than 10 inches long.

A *large surface check* is one over $\frac{1}{32}$ inch wide and over 10 inches long.

An *end check* is one occurring on an end of a piece.

A *through check* is one extending from one surface through the piece to the opposite surface or to an adjoining surface.

A *heart check* is one starting at the pith and extending toward but not to the surface of a piece.

CROSS BREAKS

A *cross break* is a separation of the wood cells across the grain, such as may be due to tension resulting from unequal shrinkage or mechanical stresses.

CROSS GRAIN

Cross-grained wood is that in which the cells or fibers do not run parallel with the axis, or sides of a piece.

Slight cross grain is a slope of the grain not over 1 inch in a length of 15 inches.

Medium cross grain is a slope of the grain over 1 inch in a length of 15 inches but not more than 1 inch in a length of 10 inches.

Steep cross grain is a slope of the grain over 1 inch in a length of 10 inches.

DECAY

Decay is a disintegration of the wood substance due to the action of wood-destroying fungi. The words "dote" and "rot" mean the same as decay.

Incipient decay is the early stage of decay in which the disintegration has not proceeded far enough to soften or otherwise change the hardness of the wood perceptibly. It is usually accompanied by a slight discoloration or bleaching of the wood.

Firm red heart is a stage of incipient decay characterized by a reddish color produced in the heartwood, which does not unfit the wood for the majority of yard purposes.

Water soak (or stain) is a term applied to a generally water-soaked area in heartwood, which is usually interpreted as the incipient stage of certain wood rots.

Advanced (or typical) decay is the older stage of decay in which the disintegration is readily recognized because the wood has become punky, soft and spongy, stringy, ring shaked, pitted, or crumbly. Decided discoloration or bleaching of the rotted wood is often apparent.

A *pocket rot* is typical decay which appears in the form of a hole, pocket, or area of soft rot, usually surrounded by apparently sound wood.

GUM SPOTS AND STREAKS

A *gum spot* or *streak* is an accumulation of gumlike substance occurring as a small patch or streak in a piece. It may occur in conjunction with a bird peck or other injury to the growing wood. In size they are classified the same as pitch pockets or pitch streaks.

HOLES

Holes in wood may extend partially or entirely through the piece and be from any cause. When holes are permitted, the average of the maximum and minimum diameters measured at right angles to the direction of the hole shall be used in measuring the size, unless otherwise stated.

A *pinworm hole* is one not over 1/16 inch in diameter.

A *medium worm hole* is one over 1/16, but not more than 1/4, inch in diameter.

A *large worm hole* is one over 1/4 inch in diameter.

IMPERFECT MANUFACTURE

Imperfect manufacture includes all defects or blemishes which are produced in manufacturing, such as chipped grain, loosened grain, raised grain, torn grain, skips in dressing, hit and miss, variation in sawing, miscut lumber, machine burn, machine gouge, mismatching, and insufficient tongue or groove.

Chipped grain means that a part of the surface is chipped or broken out in very short particles below the line of cut. It should not be classed as torn grain and, as usually found, shall not be considered a defect, unless it is present in excess of 25 per cent of the area.

Loosened grain means that a small portion of the wood has become loosened but not displaced.

Raised grain is a roughened condition of the surface of dressed lumber in which the hard summer wood is raised above the softer spring wood, but not torn loose from it.

Torn grain means that a part of the wood is torn out in dressing, and in depth is of four distinct characters, slight, medium, heavy, and deep.

Slight torn grain is not over 1/32 inch in depth.

Medium torn grain is over 1/32, but not more than 1/16 inch in depth.

Heavy torn grain is over 1/16, but not more than 1/8 inch in depth.

Deep torn grain is over 1/8 inch in depth.

A *skip* is an area on a piece that failed to surface.

A *slight skip* is one that failed to surface smoothly, whose area does not exceed the product of the width of the piece in inches multiplied by 6.

A *heavy skip* is one that the planer knife did not touch.

Hit and miss is a series of skipped spots with surfaced areas between, or with skips the entire length when not over 1/16 inch in depth.

Variation in sawing is a deviation from the line of cut. Slight variation is not more than 1/16 inch in 1-inch material, 1/8 inch in 2-inch, 3/16 inch in 3 to 7 inch, and 1/4 inch in 8-inch and up.

Miscut lumber is that which has a greater variation in thickness or width at different places on the piece than specified for variation in sawing.

A *machine burn* is a darkening or charring of the wood due to overheating by machine knives.

A *machine gouge* is a groove across a piece due to the machine cutting below the desired line of cut.

Mismatched material is worked material that does not fit tightly at all points of contact between adjoining pieces, or in which the surfaces of adjoining pieces are not in the same plane.

Courtesy of Bureau of Foreign and Domestic Commerce

Plate XVII—Loading lumber at Seattle, Washington, for export to Japan. Note that the material piled on the dock ready for shipment ranges from logs and heavy "squares" to "two-by-fours."

Courtesy Forest Products Laboratory

Plate XVIII—The mills are cutting just as high quality stock as they did years ago. Note the size of these cants, which will produce practically clear lumber.

Slight mismatch is a surface variation not over 1/64 inch.
Medium mismatch is a surface variation over 1/64 but not more than 1/32 inch.
Heavy mismatch is a surface variation over 1/32 inch.

KNOTS

A *knot* is a branch or limb embedded in the tree which has been cut through in the process of lumber manufacture. Knots are classified according to size, form, quality, and occurrence. The average of the maximum and minimum diameters shall be used in measuring the size of knots, unless otherwise stated.

SIZE

A *pin knot* is one not over 1/2 inch in diameter.
A *small knot* is one over 1/2 inch, but not more than 3/4 inch in diameter.
A *medium knot* is one over 3/4 inch, but not more than 1 1/2 inches in diameter.
A *large knot* is one over 1 1/2 inches in diameter.

FORM

A *round knot* is one oval or circular in form.
A *spike knot* is a branch or limb sawed in a lengthwise direction.

QUALITY

A *sound knot* is solid across its face, as hard as the surrounding wood, and shows no indications of decay. It may vary in color from red to black.
An *unsound knot* is solid across its face, but contains incipient decay.
A *decayed knot* is softer than the surrounding wood and contains advanced decay.
A *tight knot* is one so fixed by growth or position that it will firmly retain its place in the piece.
An *intergrown knot* is one whose rings of annual growth are completely intergrown with those of the surrounding wood.
A *water-tight knot* is one whose rings of annual growth are completely intergrown with those of the surrounding wood on one surface of the piece, and which is sound on that surface.

NOTE.—Definitions for sound, tight, intergrown, or water-tight knots may be combined in one or more definitions.

An *encased knot* is one whose rings of annual growth are not intergrown and homogeneous with those of the surrounding wood. The encasement may be partial or complete; or pitch or bark.
A *"not firm" knot* is one which under ordinary conditions will hold its place in a dry board and yet under pressure can be started but not easily pushed out of the piece.
A *loose knot* is one not held firmly in place by growth or position and cannot be relied upon to remain in place in the board.
A *pith knot* is a sound knot with a pith hole not more than 1/4 inch in diameter.
A *hollow knot* is an apparently sound knot with a relatively large hole in it.

OCCURRENCE

A *single knot* is one occurring by itself with the fibers of the wood in which it occurs deflected around it.
A *knot cluster* is two or more knots grouped together as a unit with the fibers of the wood deflected around the entire unit. A group of single knots is not a knot cluster.
Branch knots are two or more knots branching from a common center.

PITCH

Pitch is a poorly defined accumulation of resin in the wood cells in a more or less irregular patch.
Light pitch is the lightly evident presence of pitch.
Medium pitch is a slightly more evident trace of pitch than is the light.
Heavy pitch is the very evident presence of pitch showing by its color and consistency.
Massed pitch is a clearly defined accumulation of solid pitch in a body by itself in a piece of lumber.

PITCH POCKETS

A *pitch pocket* is a well-defined opening between rings of annual growth, usually containing, or which has contained, more or less pitch, either solid or liquid. Bark also may be present in the pocket.

A *very small pitch pocket* is one not over $\frac{1}{8}$ inch in width and not over 2 inches in length.

A *small pitch pocket* is one not over $\frac{1}{8}$ inch in width and not over 4 inches in length, or not over $\frac{1}{4}$ inch in width and not over 2 inches in length.

A *medium pitch pocket* is one not over $\frac{1}{8}$ inch in width and not over 8 inches in length, or not over $\frac{3}{8}$ inch in width and not over 4 inches in length.

A *large pitch pocket* is one whose width or length exceeds the maximum stated as permissible for a medium pitch pocket.

A *closed pitch pocket* is one that does not show an opening on both sides of the piece.

PITCH SEAMS

A *pitch seam* is a shake or check which is filled with pitch.

PITCH STREAKS

A *pitch streak* is a well-defined accumulation of pitch in a more or less regular streak.

A *small pitch streak* is one not over one-twelfth the width by one-sixth the length of the surface on which it occurs.

A *medium pitch streak* is one over one-twelfth but not more than one-sixth the width by over one-sixth but not more than one-third the length of the surface on which it occurs.

A *large pitch streak* is over one-sixth the width by one-third the length of the surface on which it occurs.

PITH

Pith is the small soft core occurring in the structural center of a log. The wood immediately surrounding the pith often contains small checks, shakes, or numerous pin knots, and is discolored; any such combination of defects and blemishes is known as *heart-center.*

PITH FLECKS

A *pith fleck* is a narrow streak resembling pith, usually brownish, up to several inches in length on the surface of a piece resulting from burrowing of larvæ in the growing tissue of the tree.

SHAKE

A *shake* is a lengthwise separation of the wood, which occurs usually between and parallel to the rings of annual growth.

A *fine shake* is one with a barely perceptible opening.

A *slight shake* is one with more than a perceptible opening but not over $\frac{1}{32}$ inch in width.

A *medium shake* is one with an opening over $\frac{1}{32}$ but not more than $\frac{1}{8}$ inch wide.

An *open shake* is one with an opening over $\frac{1}{8}$ inch wide.

A *through shake* is one extending from one surface through the piece to the opposite surface or to an adjoining surface.

SPLITS

A *split* is a lengthwise separation of the wood, due to the tearing apart of the wood cells.

A *short split* is one whose length does not exceed either the width of a piece or one-sixth its length.

A *medium split* is one whose length exceeds the width of a piece, but does not exceed one-sixth its length.

A *long split* is one whose length exceeds one-sixth the length of a piece.

STAIN (OR DISCOLORATION)

Stain is a discoloration, occurring on or in lumber, of any color other than the natural color of the piece on which it appears. It is classified as light, medium, and heavy.

Light stain is a slight difference in color which will not materially impair the appearance of the piece if given a natural finish.

Medium stain is a pronounced difference in color which, although it does not obscure the grain of the wood, would customarily be objectionable in a natural but not in a painted finish.

Heavy stain is a difference in color so pronounced as practically to obscure the grain of the wood.

WANE

Wane is bark, or the lack of wood or bark, from any cause, on the edge or corner of a piece.

Slight wane is not over ¼ inch wide on the surface on which it appears, for one-sixth the length and one-fourth the thickness of the piece.

Medium wane is over ¼ inch but not more than ½ inch wide on the surface on which it appears, for one-sixth the length and one-fourth the thickness of the piece.

Large wane is over ½ inch wide on the surface on which it appears, and/or over one-sixth the length and one-fourth the thickness of the piece.

WARP

Warp is any variation from a true or plane surface. It includes bow, crook, cup, or any combination thereof.

Bow is a deviation flatwise from a straight line drawn from end to end of a piece and is measured at the point of greatest distance from the straight line.

Crook is a deviation edgewise from a straight line drawn from end to end of a piece and is measured at the point of greatest distance from the straight line. It is known as slight, small, medium, and large.

Based on a piece 4 inches wide and 16 feet long, the distances for the different degrees of crook shall be: For *slight crook*, a maximum of 1 inch; *small crook*, 1½ inches; *medium crook*, 3 inches; and *large crook*, over 3 inches. For wider pieces it shall be ⅛ inch less for each additional 2 inches of width. Shorter or longer pieces may have the same curvature.

Cup is a curve in a piece across the grain or width of a piece. It is measured at the point of greatest deviation from a straight line drawn from edge to edge of a piece. It is known as slight, medium, and deep.

Based on a piece 12 inches wide, the distances for the different degrees of cup shall be: For *slight cup*, a maximum of ¼ inch; *medium cup*, ⅜ inch; and *deep cup*, ½ inch. Narrower or wider pieces may have the same curvature.

Appendix C.—American Standard Patterns for Worked Lumber

The following workings for different items of yard lumber shall be considered *standard*. All workings not specifically illustrated, or not described by footnote, shall be considered *special*.

The size, shape, and location of the tongue and groove, or lap, in all worked yard lumber items, except drop siding and rustic, are identical for all standard widths provided in paragraph 39, for each item, but vary with the thickness of that item.

Appendix E.—Recommended Specifications for Standard Grades or Red Cedar Shingles

A	B	C	D
To be strictly clear, edge grain, and free from sap. Random widths.	To be strictly clear, mixed edge grain and flat grain, ½ inch sap, measured 5 inches from butt, on one edge only permitted.	10-inch clear butts and better for 16 and 18 inch shingles and 16-inch clear butts and better for 24-inch shingles not permitted in higher grades. Sap permitted.	6 to 10 inch clear butts. Sap permitted.

Appendix E.—*Continued*

A	B	C	D
24″ Shingles 4/2″	24″ Shingles 4/2″	24″ Shingles 4/2″	24″ Shingles 4/2″
No shingle to be narrower than 4 inches. If packed by "M" must count 14/14 courses to bunch, 9 bunches to "M." Bunches must measure 7 inches across butts when green, 6¾ inches when dry. If packed by "square" must count 14/14 courses to bunch, 4 bunches to "square," 7½-inch exposure, and 3 bunches to "square," 10-inch exposure. Bunches must measure 7 inches across butts when green, 6¾ inches when dry.	None.	No shingle to be narrower than 3 inches. If packed by "M" must count 14/14 courses to bunch, 9 bunches to "M." Bunches must measure 6¾ inches across butts when green, 6⅛ inches when dry. If packed by "square" must count 14/14 courses to bunch, 4 bunches to "square," 7½-inch exposure, and 3 bunches to "square," 10-inch exposure. Bunches must measure 8⅛ inches across butts when green, 7⅞ inches when dry.	No shingle to be narrower than 2 inches. Permits shims and feather tips 20 inches long. If packed by "M" must count 14/14 courses to bunch, 9 bunches to "M." Bunches must measure 6¾ inches across butts when green, 6½ inches when dry. If packed by "square" must count 14/14 courses to bunch, 4 bunches to "square," 7½-inch exposure, and 3 bunches to "square," 10-inch exposure. Bunches must measure 6¾ inches across butts when green, 6½ inches when dry.
18″ Shingles 5/2¼″	18″ Shingles 5/2¼″	18″ Shingles 5/2¼″	18″ Shingles 5/2¼″
No shingle to be narrower than 3 inches. If packed by "M" must count 20/20 courses to bunch, 5 bunches to "M." Bunches must measure 9 inches across butts when green, 8¾ inches when dry. If packed by the "square" must count 18/18 courses to bunch, 4 bunches to "square." Bunches must measure 8⅛ inches across butts when green, 7⅞ inches when dry.	No shingle to be narrower than 3 inches. If packed by "M" must count 20/20 courses to bunch, 5 bunches to "M." Bunches must measure 9 inches across butts when green, 8¾ inches when dry. If packed by the "square" must count 18/18 courses to bunch, 4 bunches to "square." Bunches must measure 8⅛ inches across butts when green, 7⅞ inches when dry.	No shingle to be narrower than 2½ inches. If packed by "M" must count 20/20 courses to bunch, 5 bunches to "M." Bunches must measure 8¾ inches across butts when green, 8½ inches when dry. If packed by the "square" must count 18/18 courses to bunch, 4 bunches to "square." Bunches must measure 7⅞ inches across butts when green, 7⅝ inches when dry.	No shingle to be narrower than 2 inches. Permits shims and feather tips 16 inches long. If packed by "M" must count 20/20 courses to bunch, 5 bunches to "M." Bunches must measure 8¾ inches across butts when green, 8½ inches when dry. If packed by the "square" must count 18/18 courses to bunch, 4 bunches to "square." Bunches must measure 7⅞ inches across butts when green, 7⅝ inches when dry.
16″ Shingles 5/2″	16″ Shingles 5/2″	16″ Shingles 5/2″	16″ Shingles 5/2″
No shingle to be narrower than 3 inches. If packed by "M" must count 25/25 courses to bunch, 4 bunches to "M." Bunches must measure 10 inches across butts when green, 9¾ inches when dry. If packed by the "square" must count 20/20 courses to bunch, 4 bunches to "square," or 5 to "M." Bunches must measure 8 inches across butts when green, 7¾ inches when dry.	No shingle to be narrower than 3 inches. If packed by "M" must count 25/25 courses to bunch, 4 bunches to "M." Bunches must measure 10 inches across butts when green, 9¾ inches when dry. If packed by "square" must count 20/20 courses to bunch, 4 bunches to "square," or 5 to "M." Bunches must measure 8 inches across butts when green, 7¾ inches when dry.	No shingle to be narrower than 2½ inches. If packed by "M" must count 25/25 courses to bunch, 4 bunches to "M." Bunches must measure 9¾ inches across butts when green, 9½ inches when dry. If packed by the "square" must count 20/20 courses to bunch, 4 bunches to "square," or 5 to "M." Bunches must measure 7¾ inches across butts when green, 7½ inches when dry.	No shingle to be narrower than 2 inches. Permits shims and feather tips 14 inches long. If packed by "M" must count 25/25 courses to bunch, 4 bunches to "M." Bunches must measure 9½ inches across butts when green, 9¼ inches when dry. If packed by the "square" must count 20/20 courses to bunch, 4 bunches to "square" or 5 to "M." Bunches must measure 7½ inches across butts when green, 7¼ inches when dry.

GENERAL RULES

All A and B grade shingles must be parallel (a 16 or 18 inch A or B shingle not over ¼ inch off parallel or a 24 inch A shingle not over ⅜ inch off parallel shall be considered parallel), uniform in thickness, and well manufactured. This means shims and feather tips are not permitted; smoothness of faces and butts must be first class. Badly cross-grained shingles not permitted. The color of wood is not a defect in any grade.

No full flat-grain shingle wider than 10 inches permitted in grade B, and no shingle wider than 14 inches permitted in A and B grades; 1 inch over and under in length is permitted in 10 per cent. Shingles cut from equalized blocks may be ¼ inch less than the standard length. C grade admits slight irregularities in thickness. A shingle in C grade, not over ⅜ inch off parallel, shall be considered parallel.

Where reference is made to edge grain, percentage of edge grain shall be determined by the proportion of actual lineal measurement of edge grain to full lineal measurement of shingles.

In 16 and 18 inch A and B grades not more than 10 per cent of any shipment may be less than 4 inches in width.

All shingles to be packed in straight courses in regulation frames 20 inches in width with band sticks not less than 19½ inches long. Opening shall not exceed an average of 1 inch to the course in random width shingles.

Discrepancy in inspection in any grade shall not exceed 4 per cent.

Supplementary Statement

(Illustrative of the Methods of Description and Measurement of Yard Lumber under American Lumber Standards. Adopted by the Central Committee on Lumber Standards at Meeting July 1, 1924, Chicago, Ill.)

These tables include certain illustrative combinations of standard and nonstandard widths and thicknesses. It is hoped and assumed that the yard lumber sizes provided in the association grading rules will be confined to the American standard sizes. These examples show the description, measurement, and invoicing prescribed by American Lumber Standards to apply to yard lumber sizes provided in association grading rules, under which lumber is manufactured and sold. Tables 22 and 23 illustrate the measurement of "lumber finished to special size." Such lumber, under paragraph 45 of the American Lumber Standards, "shall be counted (tallied) as of the standard rough size necessarily used in its manufacture."

Paragraph 50 prescribes the method of invoicing yard lumber which is "not of standard size," including, therefore, "lumber finished to special size."

TABLE 20

EXAMPLES OF APPLICATION TO YARD LUMBER SIZES

[Based on finish, boards, and dimension: 12-foot length]

Example	*Finished Thickness (S1S or S2S)*	*Finished Width (S1E or S2E)*	*Board Measurement*	*As Provided in Paragraph—*	*To be Invoiced as—*	*As Provided in Paragraph—*
	Inches	*Inches*	*Feet*			
1. Finish	25/32	5½	6	44, 46	1 by 6 inches (standard yard)	42
2. Boards	1 5/16	5⅝	9	43, 44	1½ by 6 inches (standard yard)	42
3. Dimensions	1⅝	3⅝	8	43, 44	2 by 4 inches (standard yard)	42
4. Finish	1¾	3½	8	43, 44	2 by 4 inches (standard industrial)	42
5. Finish	13/16	7¼	8	44, 46	1 by 8 inches (standard industrial)	42

TABLE 21

EXAMPLES OF APPLICATION TO WORKED LUMBER

[Based on 12-foot length]

Example	*Finished Thickness*	*Face Width*	*Board Measurement*	*As Provided in Paragraph—*	*To be Invoiced as—*	*As Provided in Paragraph—*
		Inches	*Feet*			
1.....	½ by 3/16 inch (bevel siding).	3½	4	43, 44	½ by 3/16 by 4 inches (standard)..	42
2.....	9/16-inch (rustic).....	4⅛	5	43, 44	9/16 by 5 inches (standard).....	42
3.....	11/16-inch (ceiling).....	5 3/16	6	43, 44	11/16 by 6 inches (standard).....	42
4.....	25/32-inch (flooring).....	2⅜	3	43, 44, 46	1 by 3 inches (standard)	42
5.....	1 1/16-inch (D & M).....	7¼	10	43, 44, 46	1¼ by 8 inches (standard).....	42

TABLE 22

EXAMPLES OF APPLICATION TO "LUMBER FINISHED TO SPECIAL SIZE" IN YARD LUMBER

[Based on finish, boards, and dimension; 12-foot length]

Example	*Finished Thickness (S1S or S2S)*	*Finished Width (S1E or S2E)*	*Board Measurement*	*As Provided in Paragraph—*	*To be Invoiced as—*	*As Provided in Paragraph—*	*"Standard Rough Size Necessarily Used in its Manufacture" (Par. 45)*
	Inches	*Inches*	*Feet*		*Inches*		*Inches*
1.....	¾	5⅜	6	45	¾ by 5⅜.....	50	1 by 6
2.....	1	7¼	10	45	1 by 7¼.....	50	1¼ by 8
3.....	1½	11¼	21	45	1½ by 11¼.....	50	1¾ by 12
4.....	2	3¼	10	45	2 by 3¼.....	50	2½ by 4
5.....	3½	7	32	45	3½ by 7.....	50	4 by 8

TABLE 23

EXAMPLES OF APPLICATION TO "LUMBER FINISHED TO SPECIAL SIZE" IN WORKED LUMBER

[Based on 12-foot length]

Example	*Finished Thickness*	*Face Width*	*Board Measurement*	*As Provided in Paragraph—*	*To be Invoiced as—*	*As Provided in Paragraph—*	*"Standard Rough Size Necessarily Used in its Manufacture" (Par. 45)*
		Inches	*Feet*		*Inches*		*Inches*
1.....	1½-inch (decking, D&M)...	8¾	20	45	1½ by 8¾.....	50	2 by 10
2.....	½-inch (ceiling).....	2⅛	3	45	½ by 2⅛.....	50	3 (width)
3.....	1-inch (shiplap).....	7	10	45	1 by 7.....	50	1¼ by 8
4.....	15/16-inch (flooring).....	2¼	3¾	45	15/16 by 2¼.....	50	1¼ by 3
5.....	⅝-inch (partition).....	2¾	4	45	⅝ by 2¾.....	50	4 (width)

The foregoing extracts are but a portion of American Lumber Standards as published. The complete edition, including a series of very valuable illustrations of cross-sections and specifications of flooring, ceiling, siding, moldings, etc., are contained in *Lumber—Simplified Practice Recommendation No. 16*—Bureau of Standards.

(See general Bibliography for publishers' adddresses.)

Measuring Units Used in Export of Lumber

Many of the countries in Europe and the Orient which yearly import large amounts of American cut lumber have formulated various measuring units adaptable for their particular use.

In this country export stock is measured and tallied on the basis of 1,000 board feet. After its receipt in foreign countries, prices are quoted in units of measurement in current use.

It is practically impossible in a publication of this nature thoroughly to discuss these units. A great deal of confusion exists at the present time, and in the past many units were in common use. (See Plate XVII.)

In recent years there has been a decided tendency to adopt the cubic meter or cubic foot system. In general, the Petrograd Standard (formerly known as the St. Petersburg Standard) is used throughout Europe for cargo shipments of Baltic, Prussian, Scandinavian, and American softwood lumber. In addition, in practically all these countries the metric system (cubic meter) or the cubic foot basis is used for hardwoods.

The Petrograd Standards, "the measurement of the infernal," as it is sometimes called, has a queer history. Apparently no one knows how and why it was developed. It is a "relic" from ancient Russia. A short time ago an attempt was made by the new régime in Russia to change the name to Lenin Standard, but it apparently met with little success, inasmuch as the old term is still used by the trade.

Equivalents of the Petrograd Standard

1 Petrograd	Standard	contains	.....	165 cubic feet
1 "	"	"	.....	1980 board feet
1 "	"	"	.....	4.6723 cubic meters

The Standard is broken up into units, known as quarters, deals, and parts, or may be expressed in decimal parts. To convert the Standard and its units into board feet or cubic feet, or vice versa, the following procedure is used:

In export shipments practically all lumber is shipped on a piece tally, giving number of piece, width, thickness, and length

Convert all dimensions into inches by multiplying the number of pieces by width, thickness, and length

The result will represent the total number of inches

Using then a common divisor which is standard, and dividing the total number of inches by 11, 18, 30, and 4, the result will be expressed in Standards, quarters, deals, and parts

Those not familiar with this "heathenish" innovation can perhaps best understand the conversion by the following illustration:

A lot shipment of Douglas fir to England consists of:

100	pieces	— 1″ x 10″ x 10′
20	"	— 2″ x 10″ x 20′
100	"	— 4″ x 10″ x 20′
100	"	— 6″ x 10″ x 10′

How many Petrograd Standards, quarters, deals, and parts does the shipment contain?

(*a*) Reduce all dimensions to inches by multiplying the number of pieces by thickness, width, and length.

100	pieces	1″ x 10″ x 10′	=	10,000 inches
20	"	2″ x 10″ x 20′	=	8,000 "
100	"	4″ x 10″ x 20′	=	80,000 "
100	"	6″ x 10″ x 10′	=	60,000 "
320				158,000 Total inches.

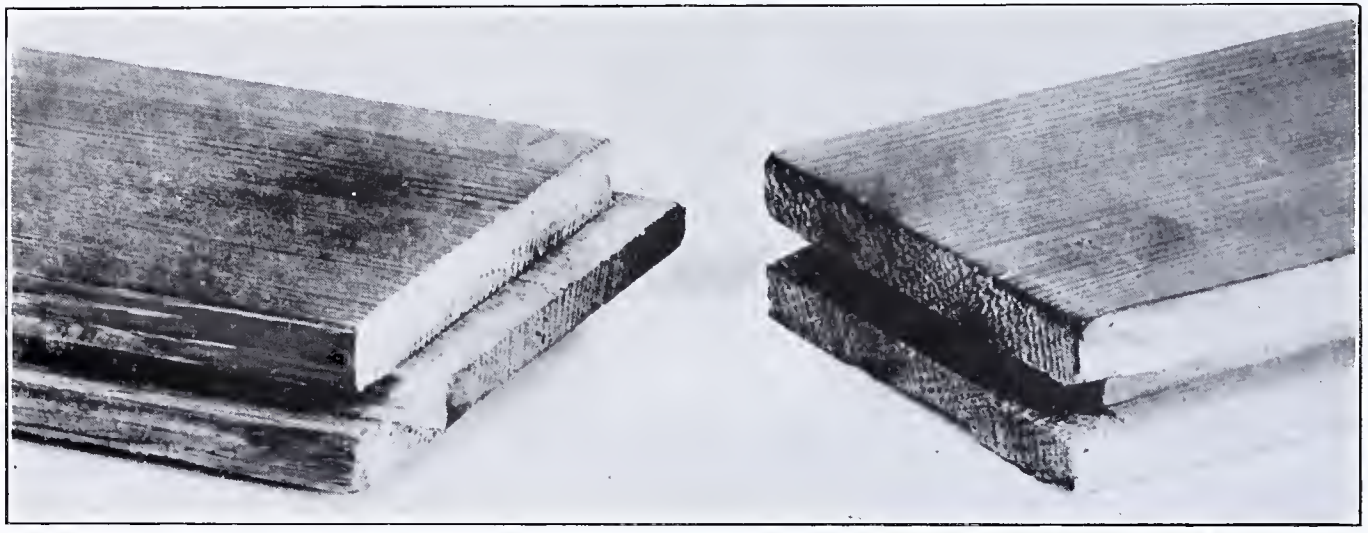
(In order to convert this figure to board feet it is necessary to divide by 12, which equals 13,166 board feet.)

(*b*) Divide total number of inches by the following *standard divisors:* 11, 18 (parts), 30 (deals), 4 (quarters). Note particularly the method of computing *parts.*

```
   14,364
11)158,000 = 14,364
   11
   48
   44
    40
    33
     70
     66
      40
      33
       7 (fractions less than 5 are dropped; if 5 or more, add 1)

    798
18)14,364
   126
    176
    162
     144
     144
      00 No parts (If a difference results, it is expressed in parts of 1/18th)

     26
30)798
    60
    198
    180
     18 = 18 deals

      6
4)26
   24
    2 = 2 quarters
```

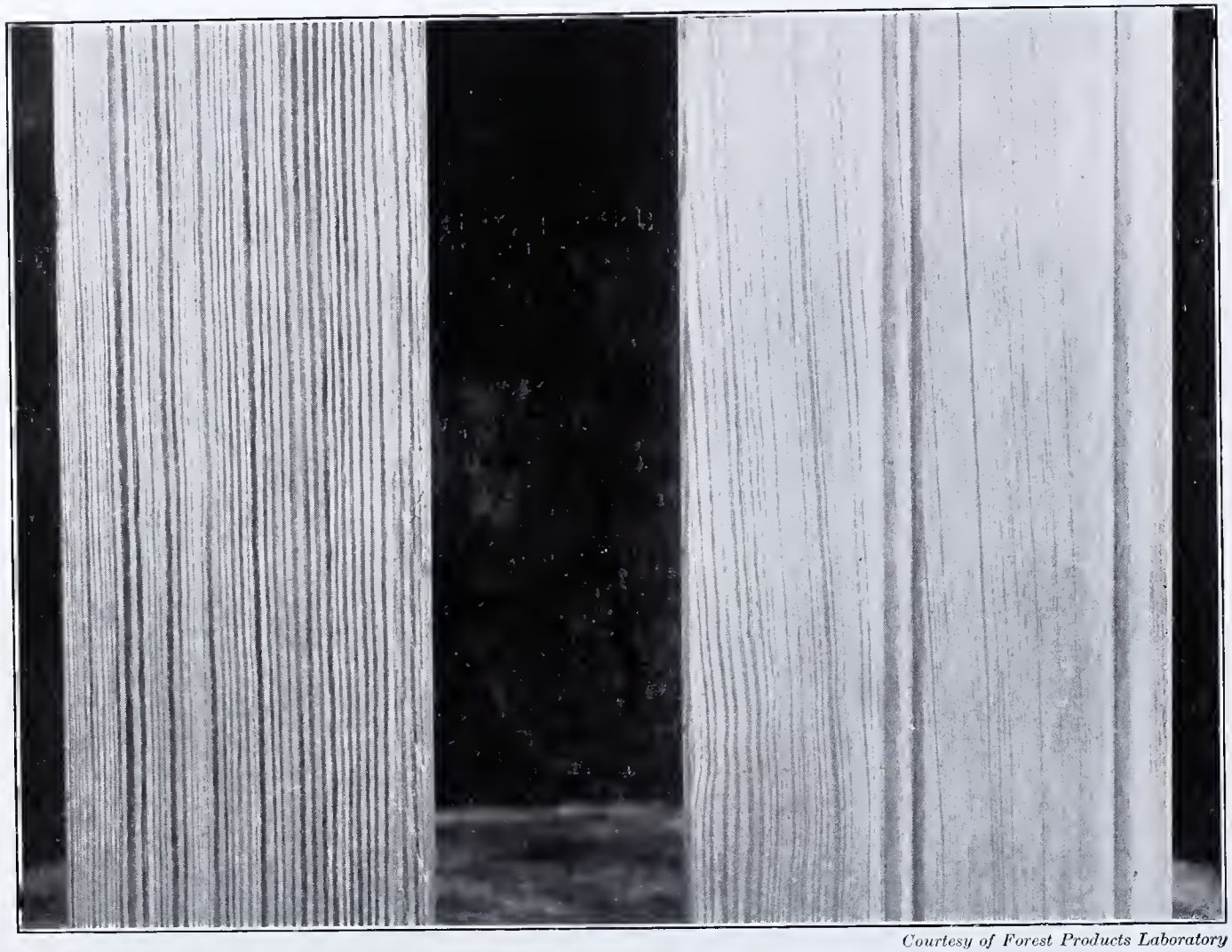
In other words, this shipment, converted into Petrograd Standards, would be 6 Standards, 2 quarters, 18 deals. (There would be *no parts.*)

Often Petrograd Standards are expressed in decimals instead of units (quarters, deals, parts). The decimal method is much preferred, because it is simple to calculate. Likewise,



Courtesy of National Committee on Wood Utilization

Plate XIX—End-matched lumber. End-matching enables two pieces of lumber to be mechanically "welded" together. Tests have shown that end-matched lumber effects a saving of 25 per cent in labor and material.



Courtesy of Forest Products Laboratory

Plate XX—An example of carefully machined flooring and ceiling. The lumber industry has spared neither time nor money in developing machinery and equipment for the production of high-grade "worked" lumber.

it is often necessary to convert the Petrograd Standard and its decimal parts into board feet and cubic meters or cubic feet.

If Petrograd Standards are expressed in Standards, quarters, deals, and parts, the following table will be of assistance in converting them into decimal parts of a Standard. These decimal parts for the sake of convenience are shown in Table 24.

TABLE 24

4ths		*18ths*		*30ths*		*30ths*	
1	.25	1	.000462	1	.00833	18	.15
2	.5	2	.000925	2	.01666	19	.15833
3	.75	3	.001388	3	.025	20	.16666
4	1 quarter	4	.091851	4	.03333	21	.175
		5	.002314	5	.04166	22	.18333
11ths		6	.402777	6	.05	23	.19166
1	.00076	7	.00324	7	.05833	24	.2
2	.00151	8	.003703	8	.06666	25	.20833
3	.00227	9	.004166	9	.075	26	.21666
4	.00302	10	.00463	10	.08333	27	.225
5	.00379	11	.00509	11	.09166	28	.23333
6	.00454	12	.005554	12	.1	29	.24166
7	.00530	13	.006017	13	.10833	30	1 deal
8	.00606	14	.00648	14	.11666	....	....
9	.00682	15	.00694	15	.125	....	....
10	.00757	16	.007406	16	.1333	....	....
....	....	17	.00787	17	.14166	....	....
....	....	18	1 parts	....	....	....	....

4ths equal quarters, 30ths equal deals, 18ths equal parts.

By using this table it is quite simple to convert standards, quarters, deals, and parts into board feet, cubic feet, or cubic meters. For example:

Convert

6 Standards, 2 quarters, 18 deals, and no parts into:

(*a*) Standards and decimal parts of standards
(*b*) Board feet
(*c*) Cubic feet
(*d*) Cubic meters

To convert Petrograd Standards into decimal parts of standards:

6 Standards = 6.0000
2 Quarters (fourths) = .5000
18 Deals (thirteenths) = .1500
No Parts (eighteenths) = .000

(If there are *parts*, simply use decimal figures as shown in table for 18ths)

The total for the above is 6.6500, or 6.65 Standards.

To convert into board feet:

1 Standard = 1980 board feet
6.65 x 1980 = *13,167 board feet*

To convert into cubic feet:

165 cubic feet = 1 Petrograd Standard
6.65 x 165 = *1097.25 cubic feet*

To convert into cubic meters:

4.6723 cubic meters = 1 Petrograd Standard
6.65 x 4.6723 = *31.071 cubic meters*

Tables Nos. 147, 148, 149, and 150, originated by the Lumber Division of the Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., can be used for converting:

Board feet to Petrograd Standards
Cubic meters into board feet
Feet into meters
Inches (by sixteenths) into millimeters

Table No. 151 is a Lumber Price Conversion Table, indicating price per thousand feet compared with equivalent price per Petrograd Standard, per cubic foot, and per cubic meter.

Lumber Measurements used in Various Countries

England:

Softwoods—Petrograd Standard
Cubic foot
Cubic meter
Load (50 cubic feet) (square timber)

Hardwoods—Cubic foot
Superfine foot (board foot)

France:

Softwoods—Petrograd Standard
Cubic foot
Cubic meter (stere)[1]
1000 board feet (square timber)

Plywood and Veneer
Square meter and square foot

Japan:

The standard lumber measurement used in Japan is the "koku."

1 koku = 10 cubic feet, or
= 120 board feet, or
= 10 cubic shaku
1 cubic shaku = 1 cubic foot

In Japan the shaku is similar to one foot, but instead of being divided into inches (12 parts), the shaku is divided into 10 parts, called "suns."

1 sun = 1.19303 inches or 30.3 millimeters
33 sun = 39.37 inches or 1 meter
10 sun = 1 shaku
1 shaku = 0.994 inches or 303 millimeters
3.3 shaku = 39.37 inches or 1 meter
3.5314 shaku = 423.768 board feet or 1 cubic meter

[1] Unit of lumber measurement is called "stere." It is equal to the cubic meter, which contains 35.314 cubic feet. 1 Cubic meter (stere) = 424 board feet.

Belgium:

In Belgium European softwoods are sold on the basis of a metric foot (one-third of a meter). American softwoods are sold on a Petrograd Standard, and when sold in small lots they are quoted on the basis of a metric foot.

Veneers are quoted on the basis of a square meter (10.764 square feet).

American hardwoods are purchased on Petrograd Standards, and subsequently sold on the basis of a metric foot to the various consuming industries.

Scandinavia:

Scandinavian countries as a whole are compelled by law to accept the metric system as standard in the measuring and sale of lumber.

In the trade, however, the English system is in vogue.

In international trade in Scandinavia rough lumber is sold by the Petrograd Standard.

Planed lumber is measured by the actual size of the rough board; and 1/4 inch in width and 1/8 inch in thickness is added to the actual measurements of planed boards.

Lumber less than one inch in thickness is always figured at its actual measurement (as above), and not by surface measure.

Italy:

The metric system (cubic or square meters) is in use for the measurement of both hardwood and softwood lumber.

Spain:

All hardwood and softwood lumber is purchased and sold on the metric system basis.

Early European Lumber Standards

Many standards were developed in the early days of lumber trade, and each of the principal ports in countries used its own particular standard to answer its own requirements. In many instances they have fallen into disuse, but now and then certain trades still use them. A few of the more important standards are given below:

Christiana Standard:

A European lumber measurement based on a piece 1 3/4 inches by 9 inches in cross-section by 11 feet in length, equal to 10 5/16 feet, board measure, One hundred and twenty (120) standards are known as a Christiana Standard hundred, equal to 1237 1/2 feet, board measure.

Drammen Standard:

A Norwegian unit of lumber measurement. It is based on a piece 2 1/3 inches by 6 1/3 inches in cross-section by 9 feet in length, equal to 12 2/16 feet, board measure. One hundred and twenty (120) standards are called a Drammen Standard hundred, equal to 1462 1/2 feet, board measure.

Dublin Standard:

See London Standard.

London Standard:

A unit of European lumber measurement. It is based on a piece 13 inches by 9 inches in cross-section by 12 feet in length, equal to 27 feet, board measure. One hundred and twenty (120) standards comprise a London Standard hundred, equal to 3240 feet, board measure.

Quebec Standard:

Formerly a unit for the measurement of deals in transactions between producer and shipper. Now confined to the measurement of Ottawa pine deals. It is based on a piece three inches by 11 inches in cross-section by 10 feet in length and contains 27½ feet, board measure. One hundred (100) Quebec standards are known as a Quebec standard hundred, equal to 2750 feet, board measure.

Riga "Last":

A European unit of lumber measurement comprising 960 feet, board measure, of sawed deals or squared timbers.

St. Petersburg Standard (Petrograd Standard):

A unit of lumber measurement in Europe. It is based on a piece 1½ inches by 11 inches in cross-section by 12 feet in length, which is equal to 16½ feet, board measure. One hundred and twenty (120) standards are known as a St. Petersburg Standard hundred, equal to 1980 feet, board measure, or 165 cubic feet.

Bibliography

The following publications relating to the lumber industry and foreign markets for its products, published by the Department of Commerce, may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., or from the district and coöperative offices of the Bureau of Foreign and Domestic Commerce, of the Department of Commerce. Those not priced are available from the Lumber Division, Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., until the supply is exhausted.

Asia, Australia, New Zealand

American Lumber in Japan (1928)—15 cents—Trade Promotion Series No. 59.

Australian Lumber Market (1926)—10 cents—Trade Information Bulletin No. 436.

China and Indo-China Markets for American Lumber (1915)—5 cents—Special Agents Series No. 104.

Forest Resources of Siberia (1925)—10 cents—Trade Information Bulletin No. 378.

Lumber Industry of the Philippine Islands, with Special Reference to Export Species (1925)—10 cents—Trade Promotion Series No. 24.

Philippine Markets for American Lumber (1915)—5 cents—Special Agents Series No. 100.

Rattan Supply of the Philippines (1915)—5 cents—Special Agents Series No. 95.

Europe and Africa

American Lumber in Belgium (1925)—10 cents—Trade Information Bulletin No. 361.

American Lumber in Switzerland (1925)—10 cents—Trade Information Bulletin No. 353

British Lumber Trade (1928)—60 cents—Trade Promotion Series No. 64.

Forest Resources, Lumber Industry, and Lumber Export Trade of Finland (1921)—30 cents—Special Agents Series No. 207.

Forest Resources, Lumber Industry, and Lumber Export Trade of Norway (1922)—30 cents—Special Agents Series No. 211.

Forestry in Sweden (1927)—10 cents—Trade Promotion Series No. 56 (Supplement to Special Agents Series No. 195).

French Lumber Market (1925)—65 cents—Trade Promotion Series No. 19.

Latvian Timber Resources and Trade—Forest Policy of Finland (1926)—10 cents—Trade Information Bulletin Series No. 408.

Lumber Market in Italy and Reconstruction Requirements (1919)—25 cents—Special Agents Series No. 182.

Lumber Markets of the Mediterranean Region and the Near East (1917)—5 cents—Miscellaneous Series No. 51.

Lumber Market of the Netherlands (1925)—45 cents—Trade Promotion Series No. 4.

Lumber Markets of Spain and Portugal (1921)—35 cents—Special Agents Series No. 201.

Notes on Forest Resources of Central Europe (1923)—Trade Information Bulletin No. 152.

Swedish Forests, Lumber Industry, and Lumber Export Trade (1921)—75 cents—Special Agents Series No. 195.

General

Directory of American Lumber Exporters (1929).

Douglas Fir and Its Uses (1929)—10 cents.

Export Lumber Trade of the United States (1918)—20 cents—Miscellaneous Series No. 67.

Pitch Pine and Its Uses (1929).

Stave Trade in Foreign Countries (1923)—15 cents—Miscellaneous Series No. 118.

LATIN AMERICA

Lumber Markets of the East Coast of South America (1916)—25 cents—Special Agents Series No. 112.

Lumber Markets of the West and North Coasts of South America (1916)—25 cents—Special Agents Series No. 117.

Methods of Handling American Lumber Imports in South America (1923)—Trade Information Bulletin No. 107.

Methods of Handling Lumber Imports in Canada, Mexico, Central America, and West Indies (1923)—Trade Information Bulletin No. 109.

Parana Pine Lumber Industry of Brazil (1927)—10 cents—Trade Information Bulletin No. 493.

Peru as a Lumber Market (1928)—10 cents—Trade Information Bulletin No. 539.

Certain mimeographs are available from the Lumber Division, Bureau of Foreign and Domestic Commerce, Dept. of Commerce, Washington, D. C. Reports for other countries are under revision.

Safeguards in the Distribution of Lumber

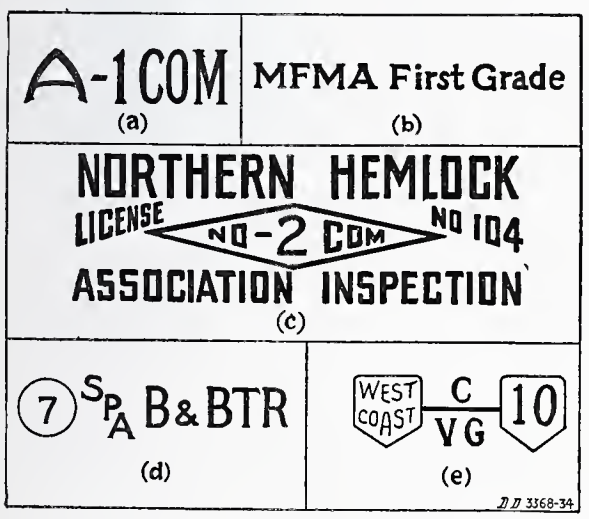
Lumber producers, distributors, and others engaged in the industry have realized the necessity of protecting the consumer in his lumber purchasing. A strong effort has been made to educate the consumer and to instil thoroughly in his mind confidence and assurance that the lumber which he uses is of the grade, size, and quality represented.

One of the most difficult problems is to safeguard the interests of the consumer in the matter of grades. Inspection is for a large part confined to service performed at the mills. Many consumers know little regarding the details of grading, and depend upon the mills, wholesalers, or other distributors to deliver to them lumber as specified. Unfortunately, from time to time, stock concerning which there were misconceptions regarding the grade, or lumber which was below grade, have confused the consumers. Such situations have often led to misunderstandings between producer and consumer and resulted in difficulties and in some cases in bitter litigation.

The industry has long appreciated the necessity for developing methods which would "identify" each piece of lumber. Several have been reduced from theory to practice, and have received much favorable comment from the consumer.

Grade Marking of Lumber

Grade marking is the placing of the grade represented upon each piece of lumber by symbols, numbers, or marks. The stamping is done with a rubber stamp or by a steel die which imprints the mark in the face or end of the board. It is made on the ends or in some cases (flooring) on the bottom of the piece. The actual grade marking is performed at the mills by expert graders.



Courtesy of National Committee on Wood Utilization

Illustration 14—A few types of grade marks used by mills of lumber manufacturers' associations. (*a*) Grade mark of Arkansas Soft Pine Bureau; (*b*) Maple Flooring Manufacturers' Association; (*c*) Northern Hemlock and Hardwood Manufacturers' Association; (*d*) Southern Pine Association; (*e*) West Coast Lumbermen's Association.

Some manufacturers have long used trade-marks on their stock, but this procedure should not be considered the same as grade marking.

At the present time grade marks are confined to the following general types (see Illustration 14):

Grade marks of the regional lumber associations and a producing mill

A trade-mark of a producing mill and a grade trade-mark of the regional association

Grade trade-mark of the National Lumber Manufacturers Association and a regional association

With the advancement of American Lumber Standards, the National Lumber Manufacturers Association and its regional associations appreciated the necessity of tying up grade marks with American standard lumber. In other words, lumber which is thus grade marked guarantees standard grades.

Producing mills are licensed to use grade and trade-marks as developed by the various lumber associations only upon guarantee that such lumber is in accordance with standards advocated by these associations.

As a further guarantee, the National Lumber Manufacturers Association has developed the "Tree-Mark," a registered and nationally advertised brand. License to use the Tree-Mark is available on the same terms to every lumber manufacturer in the United States who produces carefully sawed lumber of standard grades and is willing to submit his production to such measures of policing by the industry as may be necessary to insure the uniform maintenance of the standard grades. Its use is not permitted on lumber sold mill-run or log-run or lumber sold in mixed grades, not described in published grading rules, unsorted stocks, or specially cut stock.

A grade mark interprets the following facts:

The grade of lumber

The producing mill's identification number—supplied by a regional association

A symbol or letters designating the name of the regional association

In addition, the Tree-Mark may be shown, indicating that the association and mill are licensed to use this mark as a further guarantee of quality and grade. Sometimes producing mills insert the name of the firm in the grade mark.

Grade marking is at present more largely confined to softwood lumber than to hardwood lumber. The following species are now being grade marked:

The several "West Coast" woods—Douglas fir, West Coast hemlock, Sitka spruce, and western red cedar; the southern pines—dense longleaf pine and shortleaf pine (Arkansas soft and North Carolina pine); eastern hemlock; tidewater cypress and tupelo

Northern white pine, Norway pine, spruces, and tamarack bear the Northern Pine Manufacturers Association marks; western yellow pine (Pondosa pine), western white pine (Idaho white pine), western larch, Douglas fir (Inland Empire), white fir, cedar, and spruces carry grade marks of Western Pine Manufacturers Association. Sugar pine, western yellow pine (California white pine), incense cedar, Douglas fir (in California), carry grade marks of the California White and Sugar Pine Manufacturers Association

Maple, beech, and birch flooring carry the grade marks of the Maple Fooring Manufacturers Association

Oak flooring carries the grade marks of the Oak Flooring Manufacturers Association

Northern hardwoods carry the grade marks of the Northern Hemlock and Hardwood Manufacturers Association and southern hardwoods carry the grade marks of the Hardwood Manufacturers Institute

Northern (white and Norway) pine, Pondosa pine, Idaho white pine, and western larch bear the trade-mark of the Western Pine Association; and redwood, of the California Redwood Association.

Regional associations will gladly supply names of producing mills which are in position to supply grade marked stock.

Car Card System

Another phase of lumber certification closely connected with grade marking is the tally card or certified car card feature. (See Illustrations 15 and 16.)

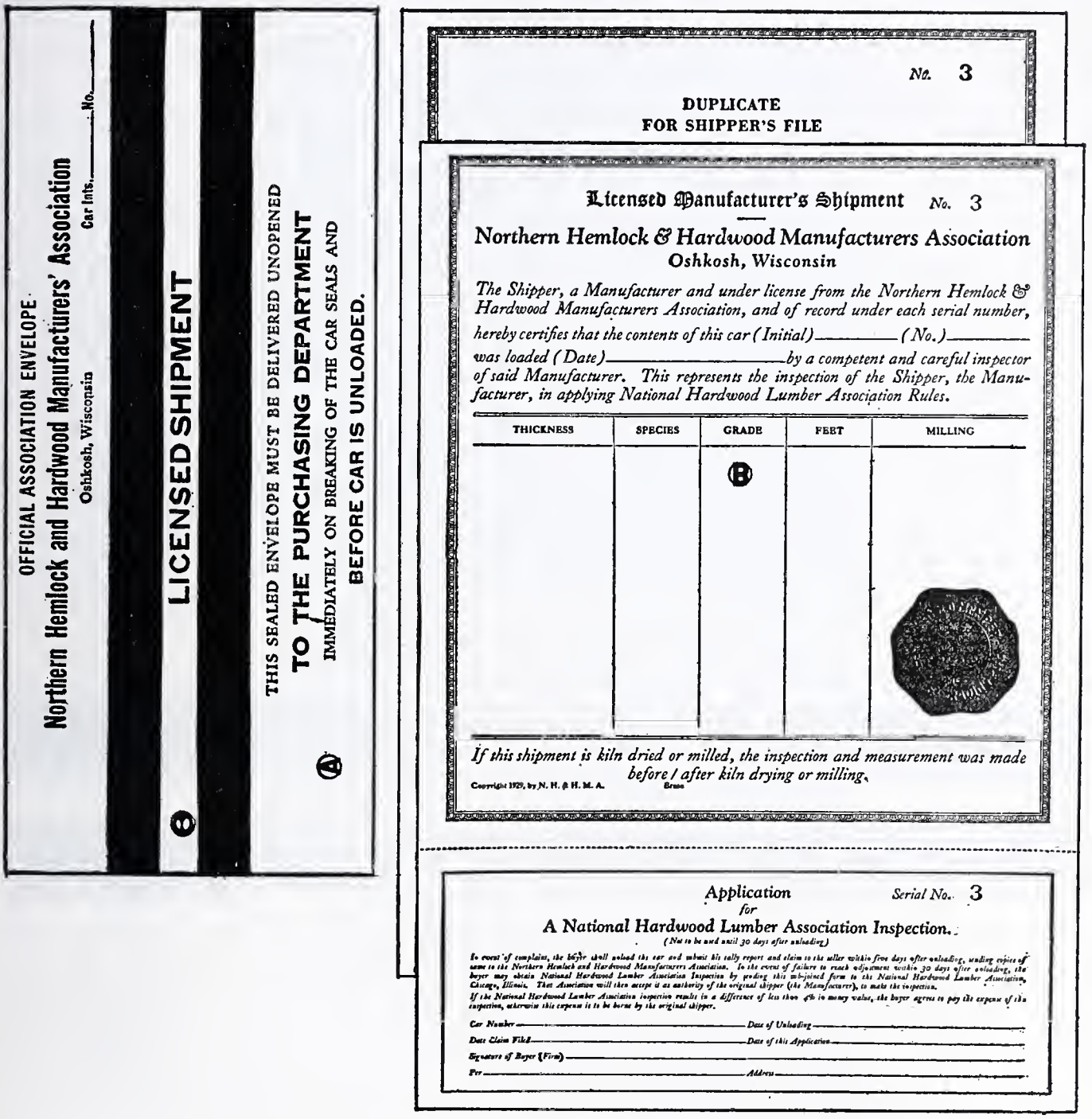
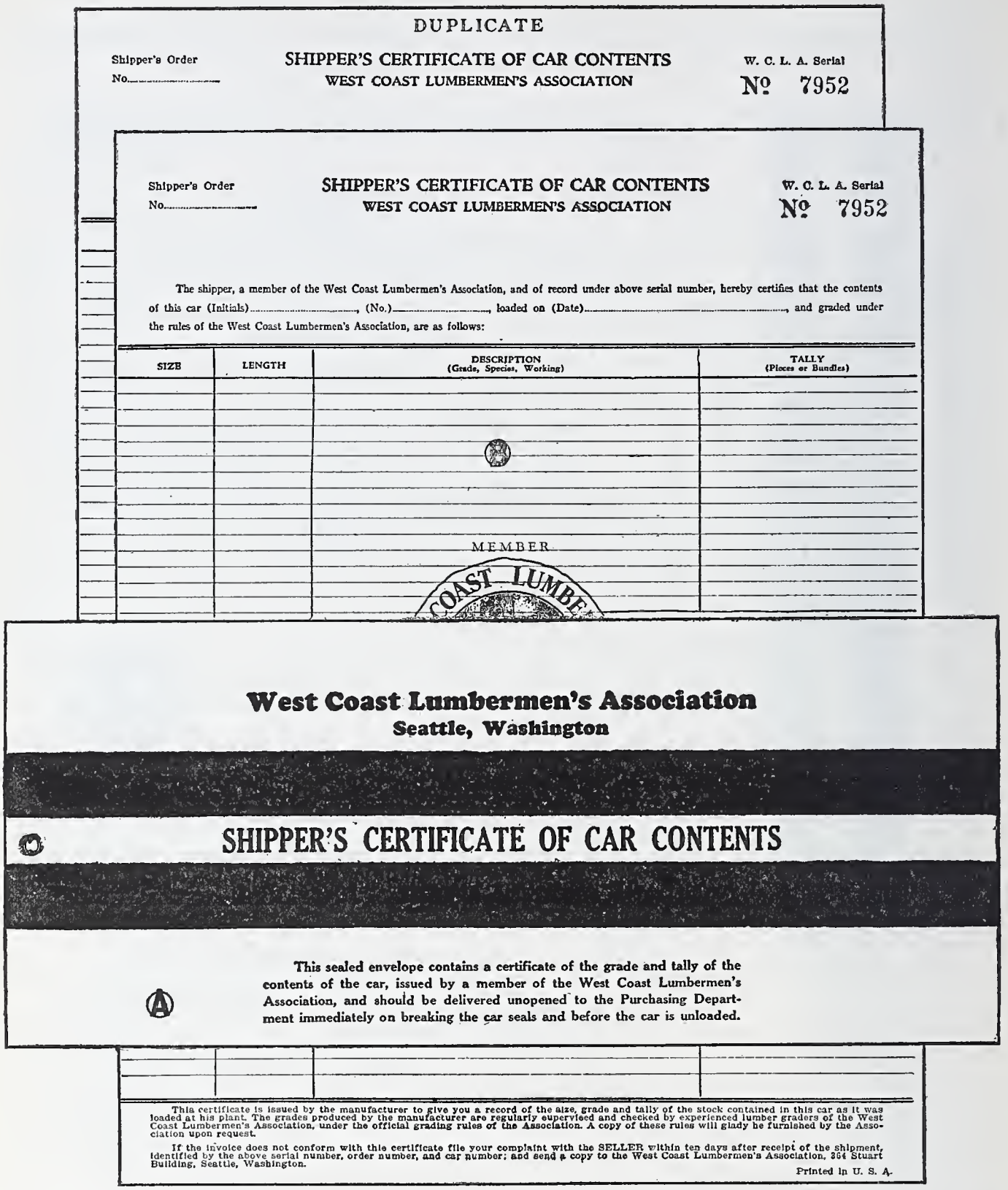

OFFICIAL ASSOCIATION ENVELOPE
Northern Hemlock and Hardwood Manufacturers' Association
Oshkosh, Wisconsin
Car Ints. No.
LICENSED SHIPMENT
THIS SEALED ENVELOPE MUST BE DELIVERED UNOPENED
TO THE PURCHASING DEPARTMENT
IMMEDIATELY ON BREAKING OF THE CAR SEALS AND
BEFORE CAR IS UNLOADED.
A
No. 3
DUPLICATE
FOR SHIPPER'S FILE
Licensed Manufacturer's Shipment No. 3
Northern Hemlock & Hardwood Manufacturers Association
Oshkosh, Wisconsin
The Shipper, a Manufacturer and under license from the Northern Hemlock & Hardwood Manufacturers Association, and of record under each serial number, hereby certifies that the contents of this car (Initial)_____ (No.)_____ was loaded (Date)_____ by a competent and careful inspector of said Manufacturer. This represents the inspection of the Shipper, the Manufacturer, in applying National Hardwood Lumber Association Rules.
THICKNESS
SPECIES
GRADE
FEET
MILLING
B
If this shipment is kiln dried or milled, the inspection and measurement was made before / after kiln drying or milling.
Copyright 1929, by N. H. & H. M. A.
Application for A National Hardwood Lumber Association Inspection.
Serial No. 3
(Not to be used until 30 days after unloading)
Car Number
Date of Unloading
Date Claim Filed
Date of this Application
Signature of Buyer (Firm)
Per
Address

Illustration 15—"Licensed Shipment," used by the Northern Hemlock and Hardwood Manufacturers' Association. The original invoice (B) is inclosed in waterproof envelope (A) which accompanies shipment. Duplicate invoices are held by the mill or shipper and the association.

The car card system provides that the originating manufacturer will place in the car loaded with lumber a card or sheet showing the number of pieces, by grades and sizes, and the total footage of lumber loaded in the car. This tally ordinarily is inclosed in a sealed envelope bearing a serial number. This number is filed with the association to which the



DUPLICATE

Shipper's Order No.

SHIPPER'S CERTIFICATE OF CAR CONTENTS
WEST COAST LUMBERMEN'S ASSOCIATION

W. C. L. A. Serial
No. 7952

Shipper's Order No.

SHIPPER'S CERTIFICATE OF CAR CONTENTS
WEST COAST LUMBERMEN'S ASSOCIATION

W. C. L. A. Serial
No. 7952

The shipper, a member of the West Coast Lumbermen's Association, and of record under above serial number, hereby certifies that the contents of this car (Initials)....., (No.)....., loaded on (Date)....., and graded under the rules of the West Coast Lumbermen's Association, are as follows:

SIZE	LENGTH	DESCRIPTION (Grade, Species, Working)	TALLY (Pieces or Bundles)

MEMBER
COAST LUMBE

West Coast Lumbermen's Association
Seattle, Washington

SHIPPER'S CERTIFICATE OF CAR CONTENTS

This sealed envelope contains a certificate of the grade and tally of the contents of the car, issued by a member of the West Coast Lumbermen's Association, and should be delivered unopened to the Purchasing Department immediately on breaking the car seals and before the car is unloaded.

This certificate is issued by the manufacturer to give you a record of the size, grade and tally of the stock contained in this car as it was loaded at his plant. The grades produced by the manufacturer are regularly supervised and checked by experienced lumber graders of the West Coast Lumbermen's Association, under the official grading rules of the Association. A copy of these rules will gladly be furnished by the Association upon request.

If the invoice does not conform with this certificate file your complaint with the SELLER within ten days after receipt of the shipment, identified by the above serial number, order number, and car number; and send a copy to the West Coast Lumbermen's Association, 364 Stuart Building, Seattle, Washington.

Printed in U. S. A.

Illustration 16—Car card tally system used by the West Coast Lumbermen's Association. The waterproof envelope (A) which contains original invoice (B) of quantity and grades shipped by the mill. Duplicate copies are held by the mill or shipper and the association.

Courtesy of E. L. Bruce Company

Plate XXI—Ample protection is given to kiln-dried lumber in transit in order to assure the consumer receiving stock free from moisture deterioration. Tight cars—doors covered with waterproof paper— eliminate such damage.

Courtesy of National Committee on Wood Utilization

Plate XXII—Kiln-dried lumber bulk-piled in storage shed. Every effort is made by lumber mills and distributors to maintain adequate stocks and grades, properly piled and stored, in order to insure lumber which will meet the demands of the consumer.

originating manufacturer belongs. It contains no company name and no means of identifying the originating shipper except in case of complaint, and then only by application to the association under rules which completely protect the distributors from encroachment upon their trade.

Such an exact record of the original shipment, with inspection and mill tally, should be valuable to every industrial consumer of carload lots, as a check upon the accuracy of inspection and tally of his own inspectors, and as a dependable safeguard against tampering in the process of distribution between producer and consumer, with either the original invoice grade or the original tally.

Inspection Service

Regional associations and producers alike have given undivided efforts to establish competent and unbiased inspection service to consumers when any question of off-grade lumber is concerned.

Particular attention is called to the inspection service available for hardwood lumber and its products established by the National Hardwood Lumber Association. This association maintains experts for the inspection of hardwood lumber under rigid standards as formulated in their standard grading rules. This organization stands ready at any time to assist in the settlement by unbiased inspection of lumber in which the element of off-grade stock is involved.

In any matters of dispute concerning softwood lumber, regional associations are in position to supply inspectors with reinspection of such lumber. In every instance, if settlement cannot be made by producing mills consumers are invited to make use of the service offered by these regional associations.

Improvements

Intensive competition and drastic economic changes in American industry have introduced a need for entirely different methods of manufacture and distribution of our commodity products. Lumber and wood products have perhaps suffered the severest effect of these conditions.

Formerly, timber was cut into lumber or other products with no regard for systematic manufacturing methods or distribution. Mills produced "boards." The best were sold and timber of the highest quality was available. Distribution was entirely local, and mills produced lumber to meet the wants of various regions. (See Plate XVIII.)

Little effort was given to refined merchandising; there was no need for it.

With the industrial progress of the United States many changes took place. The large lumber producing sections in the East and in the South showed the effect of heavy cutting. Mills moved farther from the point of consumption. Long rail and water shipments of stock became imperative.

Increasing activities in the manufacture of steel, brick, and composition products suggested uses where wood previously had been considered a necessity. Competitive producing for structural and industrial purposes began.

Producing mills sensed the need of councils for advice, and exchange of information. Lumber associations became a very potent factor in the development of the lumber industry. It was not until 1890, however, that they began to assume real importance. The original functions of the associations were to formulate and develop grading systems, inspection systems, etc. With their growth came a necessity for correlating data on produc-

tion methods and economical distribution. But beneath it all, one outstanding feature was predominant—the dissemination of mutually helpful information to both the producer and consumer of lumber and wood products.

Associations at present are spending large sums of money to furnish the consumer better information concerning the various species of wood.

Perhaps one of the greatest services rendered today is trade extension work performed by producing mills and the numerous associations for the solution of problems that confront wood consumers. It incorporates, also, development of new uses, efforts to combat the introduction and increased use of substitute materials where wood unmistakably is performing satisfactory service, projects in construction and fabrication where wood is used, and the intelligent dissemination of authoritative information on the use of wood.

Manufacturers, on the other hand, have steadily improved manufacturing methods. Lumber is now produced on improved saws; miscut lumber is reduced to a minimum. Better machine work is performed, particularly on surface and dress stock and special machine-worked patterns. (See Plates XIX and XX.)

The introduction of American Lumber Standards for softwoods has been the outstanding achievement in the elimination of a multitude of sizes and grades that for a long time confused the consumer. It is now possible to purchase stock of specified grades surfaced to definite thicknesses and widths, regardless of the region in which it is produced, with the knowledge that it is exactly comparable in size to other species produced in other regions. Grading has been greatly simplified. There are at present only eight sets of grading rules for softwood lumber.

Protection is offered the consumer by such features as the grade marking of lumber and the car card tally system. These safeguard his interests to the end that the lumber conforms to grades and species as specified.

The establishment of special grades, density rules, etc., has given the consumer stock which more precisely answers his purposes and requirements. Hearty coöperation is extended to him. Expert advice and detailed information are at his service in regard to special problems in wood fabrication.

The producing mills have long appreciated the value of dry lumber, and research has developed better drying, seasoning, and handling methods, which insure a better product. Mills are taking special pains to prevent moisture damage in shipments of kiln-dried stock. Attempts are now being made to standardize definitions for the various "drynesses" of lumber. It is only a question of time before the consumer buying seasoned stock will receive lumber of 15, 18, or 20 per cent moisture content, regardless of its source. Kiln-dried stock will be interpreted as lumber of a definite moisture content.

Special care is taken to ship lumber so as to minimize damage in transit. Damage due to shifting loads in some instances has been extremely high. Just as much care and attention are given to the loading of lumber for transit as are given to the various steps in the manufacture of lumber. (See Plate XXI.)

Mills make special efforts to keep on hand various grades and sizes which are most in demand. They are always ready, however, to cut special stock not included in their yard supply. (See Plate XXII.)

Every effort is made by mills to insure efficient and quick delivery to shippers. Unfortunately, however, transportation failures are often the cause of delayed mill shipments and criticism should not be directed against the mills in such instances.

It must be remembered that producing mills on the West Coast in some instances are several thousands of miles away from the consuming area. Because of this fact large mills have established distribution points in numerous lumber-consuming centers. Such effort on the part of producers is to expedite distribution and to place within reach of the consumers a constant supply of stock.

Each year more effort is made toward the improvement of grading rules, and toward more exacting interpretation of their significance. Expert graders are employed by mills and every care is taken to see that lumber conforms to the grades represented.

Special cut-to-length stocks partially fabricated are sometimes packed in special cardboard containers. Small dimension stock is bundled to facilitate handling. Stocks of certain grades are carefully squared and surfaced and made ready for immediate use in construction.

These are a few striking examples illustrating improvements and refinements in the production of lumber effected by producing mills in an effort to supply a "better" product to the consumer.

Ordering

The following suggestions covering points involved in a transaction between the purchaser and vendor, and constituting a lumber order, are those which are considered of importance in establishing mutual understanding. They are points which should be clearly and concisely included in every lumber order. Very often orders are incompletely or improperly made and consequently are sources for claims, litigation, and difficulties that should be unnecessary.

In most instances orders are accepted by the producer subject to conditions which are beyond his control, and include fire, floods, accidents, labor disturbances, embargoes, changes in railroad regulations, actions of the Government, wars, etc.

Producers usually make their sales f.o.b. cars, mill, or shipping points, with freight allowed to destination. Under such procedure the buyer becomes the owner as soon as the lumber is loaded on cars and a bill of lading issued, although the producer guarantees the delivered price. This relieves the latter of liability for delivery. Any damages to or loss of the lumber en route must be borne by the carrier.

In general, an order may call for a carload or a shipment of a specified number of board feet. The number of board feet in a car varies, and may range from 10,000 to 50,000 or 60,000.

Some consumers may specify, therefore:

1 small car of approximately 12,000 board feet of, etc.

or

1 large car of approximately 25,000 board feet of, etc.

Other fabricators purchase a definite limited amount, as:

10,000 feet of 4/4, etc.

6,500 feet of 6/4, etc.

The following list contains those items which should be indicated in a well-written lumber order:

The date on which the order was written

Name and address of purchaser

Number of board feet

Species, or grade, required
Whether stock is to be kiln-dried, air-seasoned, or green (indicate if possible approximate moisture content required)
Whether stock is to be rough, surfaced, or machined; the type of pattern, etc. Also state exact method of machining, dressing, and finished size, etc. (American Lumber Standards for softwood lumber have established widths and thicknesses for surfaced, dressed, or patterned stock)
Destination, shipping point, siding, or pier to which shipment is to be made
Date of delivery required or time at which shipment is to be made
Whether piece tally or board foot tally is required
In some instances, lengths required (as a rule, definite percentages of lengths based upon the grades are included in each shipment)
Specify grading rules to be used concerning the inspection of stock
In special instances specify whether lumber is to be loaded in box cars, flats, or gondolas
Specify terms of payment, discounts, etc.
Price.

Small Dimension Stock

Small dimension stock may be defined as:

Hardwood or softwood refined to the point where the maximum waste is left at the mill and the maximum of usable material is delivered for the specific requirements of a particular plant or industry. It is cut to exact size and may be in the form of squares, flat stock, rounds, billets, blanks, or other specified shapes, and may be solid or glued up. It is stock shorter than the commercial lumber length of 8 feet, and, at present, is usually cut to order. (See Illustration 17.)

During the past few years fabricators of wood products have begun to realize that the use of small dimension stock rather than long length lumber is economically sound. The advantage to the consumer in the use of small dimension may be listed as follows:

Reduced freight rates
Lower labor costs at source of supply
Reduced material inventory
Reduced equipment
Reduced ground and floor space
Reduced overhead
Definite raw material cost
Elimination of waste disposal problems

Unfortunately, up to the present time, there has been an almost complete lack of standardization of sizes and grades in the small dimension stock industry. There are several reasons for this condition, among which are the variety of uses of small dimension stock, frequent changes in requirements of consumers, various conditions under which small dimension is manufactured, etc. It is true that a number of consumers have standardized their sizes for certain requirements within their own plants, but up to date standardization has not been extended to any of the important consuming industries.

Several years ago the United States Forest Products Laboratory at Madison, Wisconsin, conducted a field study for the purpose of obtaining information which might lead to standardization of the sizes of certain parts used in the various wood-using industries,

such as for automobiles, furniture, musical instruments, agricultural implements, railway cars, wood turnings, etc. The results of this investigation have been released in the form of a report entitled, "Sizes and Quantities of Rough Cuttings Required by Hardwood Consuming Industries." Although this report forms a basis for standardization in the

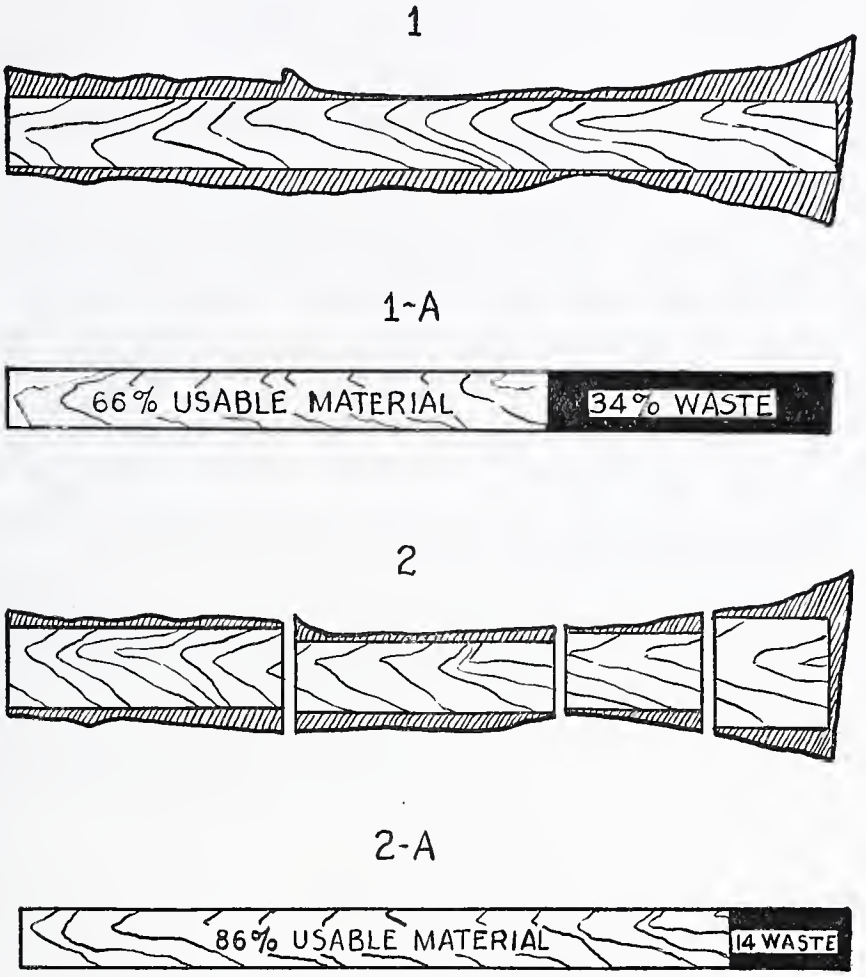


Illustration 17—Waste developed in cutting a flitch into boards and small dimension. 1. A flitch outlining board which would be cut from it. 1-A. The proportionate percentage of usable material and waste, if cut into boards. 2. Method of cutting same flitch into small dimension. 2-A. Proportionate percentage of usable material and waste resulting, if cut into small dimension.

small dimension field, little or nothing has been done to bring this standardization into effect. It is hoped that in the near future steps may be taken to remedy this condition.

It is almost impossible to make a complete list which would include all of the uses of small dimension stock. A partial list given below shows some of the important wood-using industries in which ready-cut (or small dimension) stock may be and is being used to advantage:

Agricultural implements
Automobile and truck bodies
Battery boxes
Brushes and brooms
Cabinets
Caskets and coffins
Chairs and furniture
Dairy supplies
Electrical machinery and apparatus
Laundry appliances
Machine construction
Manual training blanks
Musical instruments
Playground equipment

Plumbers' woodwork
Poulterers' and apiarists' supplies
Professional and scientific instruments
Pulleys and conveyors
Railway cars
Refrigerators
Sewing machines
Shuttles
Signs and supplies
Sporting goods
Toys
Trunks
Valises
Vehicles
Window and map rollers
Woodenware and novelties

At the present time probably 98 per cent of all small dimension stock is purchased on order specifications rather than under recognized grading rules. Several efforts have been made to prepare and put into effect inspection rules which would be applicable to the various classes of small dimension stock. These efforts have not been successful largely because of the reasons given for the lack of standardization of sizes in the industry. The National Hardwood Lumber Association has incorporated in its rule book on lumber grades, inspection rules which are intended to apply to turning squares and to furniture, flat stock and squares. The former rule has been approved by the National Association of Wood Turners, but unfortunately it has been recognized only to a limited extent by the producers and consumers of wood-turning stock.

It is almost impossible to give definite information which will enable the respective users of small dimension to locate a reliable and satisfactory source of supply of this material. Several leading lumber trade papers carry advertisements inserted by the leading firms in the production field. In nearly all cases orders given to these firms will be satisfactorily handled. A number of the members of the various lumber associations have specialized in the production of small dimension and an inquiry directed to one of the following associations will usually lead to a satisfactory contact.

National Lumber Manufacturers Association
Hardwood Manufacturers Institute
National Hardwood Lumber Association
Northern Hemlock and Hardwood Manufacturers Association
Southern Pine Association
North Carolina Pine Association

(See general list of Associations for addresses.)

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Small Dimension Stock

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Industrial Uses for Short Lengths—Especially Softwood Yard Lumber—E. D. DAVIS.
Know the Lumber you Buy—National Lumber Manufacturers Association.
Lumber—Its Manufacture and Distribution—R. C. BRYANT.
Logging—R. C. BRYANT.
Lumber and Its Uses—R. S. KELLOGG.
Lumber and Log Exporters' Guide—BERNARD BRERETON
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Wood Tank and Vat—Vol. 14, Chap. 9.—National Lumber Manufacturers Association.

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Notes on the Manufacture of Plywood—Forest Products Laboratory.
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Utilization of "Wood Waste" [1]

Lumber as raw material undergoes extensive fabrication before it assumes the dignity of a finished product. In all the steps of its utilization there occurs considerable "waste," which for the most part is unpreventable. For this reason, the lumber and wood fabricating group has a great need for the utilization of its "waste" material.

In reality the term "waste" or "wood waste" as applied in the lumber industry is incorrect, because strictly speaking "waste" is considered as "refuse, anything worthless." Again, "waste" is spoken of as "that which has no original value or no value for the ordinary or main purposes of manufacture." Research has developed many uses for this so-called "waste" material, and hence in lumber nomenclature the misused word "waste" has given place to the more appropriate term "nonutilized wood."

In this discussion "waste" refers to nonutilized wood resulting from fabrication of raw lumber and dimension, and not from the conversion of the log into lumber.

It has been clearly shown that only 45 to 50 per cent of the log is converted into rough seasoned lumber, and of the rough seasoned lumber only about 60 to 70 per cent enters into the finished product. It is the "waste" involved in this last manufacturing step that is discussed here.

Many fabricators in the past have believed that a large percentage of this "waste"

[1] The National Committee on Wood Utilization of the Department of Commerce, Washington, D. C., is quite unique in that it has for its aims and purposes the more complete utilization and elimination of waste of forest products, as an incentive to commercial reforestation. This particularly applies to their production, distribution, consumption, and fabrication. The Committee invites problems of this nature and is anxious at any time to offer assistance relative to the utilization of "wood waste."

could be utilized for other purposes. Hence, as a result of study on the part of various organizations, particularly the Forest Products Laboratory, the National Committee on Wood Utilization, numerous private organizations, and individuals, this theory of the utilization of nonutilized wood has been actually put into practice.

Wood-working plants, in some instances, have converted a large proportion of their "waste" into other products and have received a satisfactory income as a reward of such efforts.

The many possibilities of the utilization of this material, and the questions relative to its many uses, could well be discussed in a volume twice the size of this. An attempt is made here only to mention a few of the numerous methods that now offer commercial application and are considered economically sound. Four distinct methods of utilizing this type of "wood waste" are now in practice:

The use in its entirety, or its conversion into hogged material, for fuel purposes
Its remanufacture into smaller fabricated articles
Its use in the manufacture of wood pulp or fiber products
Its use for wood distillation purposes.

Frequently it is impractical for the average wood-working plant to effect the utilization of wood waste in every instance, as suggested above, particularly if chemical methods, which demand expensive machinery and equipment are required.

In such cases plants must depend upon other organizations which are in position to use this material.

Unfortunately, there are many factors which control the extent of its possible utilization and these must be carefully considered.

Freight and transportation charges usually hold the key to its solution. In most instances high rates prohibit the shipment of this material over a long distance. But careful analysis of existing conditions will enable a plant to logically determine maximum shipping distances. Some progress is now being made in a more equitable solution of transportation rates on "wood waste" material. The bulkiness, quantity, moisture content, and basic value of the material control to a large degree the distance to which it can be shipped profitably.

Truck and water transportation offer possibilities of more economical methods of transportation, and in many instances are for short hauls much more economical than rail transportation.

"Wood waste" bins, pulled by belt conveyors from the cutting-up rooms and arranged to facilitate handling and reduce costs, are economical and are to be recommended. For some purposes the form of wood waste must be segregated, i.e., trimmings, cut-offs, sawdust and sander dust, shavings and chips, etc., inasmuch as certain types of consumers demand a different type of "wood waste."

Many of these consumers demand a steady supply, and since large quantities are required to insure them a constant supply throughout the year, they are often reluctant to purchase small or staggered shipments of "wood waste" material.

Use of "Wood Waste" as Fuel

Perhaps the most common way of utilizing "wood waste" at numerous fabricating plants is to burn it as fuel. The pieces are usually run through a hog and reduced to such sizes as can be fed into the boilers by automatic stokers.

Waste

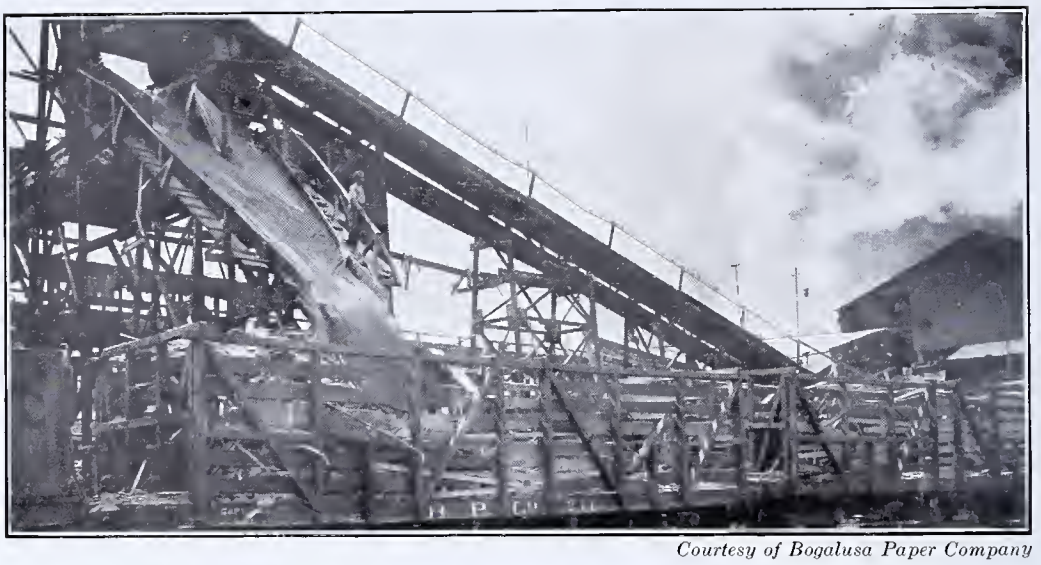
Courtesy of National Committee on Wood Utilization

Plate XXIII—Wood waste which is being sold for fuel purposes. Such loads usually bring 50 cents to $1.00. Many fabricating plants sell their wood waste for fuel without realizing its potential value for other purposes.

Salvage

Courtesy of Forest Products Laboratory

Plate XXIV—Typical mill waste which is now being used for the manufacture of small dimension and other products.



Courtesy of Bogalusa Paper Company

Plate XXV—Loading sawmill refuse on cars; to be used for paper manufacture.

Courtesy of Great Southern Lumber Company

Plate XXVI—Light wood being loaded in cars for shipment to wood distillation plant. Millions of tons of light wood (longleaf pine stumps and branches) are available for softwood distillation purposes.

Several progressive companies have perfected specially designed grates and boilers for burning this type of fuel. Others have developed efficient blowers and stokers, making automatic stoking possible.

In the use of "wood waste" for fuel purposes several items should be considered:

Whether it is more economical to burn wood fuel than coal, particularly if possible market for such material could be found

The fact that sawdust and wood trim often contain excessive moisture which reduces their value as fuel

The fact that it requires approximately 2 to 4 pounds of such wood to equal the equivalent heat value of one pound of coal. This of course varies, and depends upon many factors, such as species, boiler efficiency, moisture, etc.

Expressed in cords of various woods required to produce the same amount of heat as that produced by a ton of coal, the Forest Products Laboratory has developed the following:

It requires 1 cord of the following species of wood to equal 1 ton of good coal: hickory, oak, beech, birch, hard maple, ash, elm, locust, longleaf pine, cherry.

It requires 1½ cords of the following: shortleaf pine, western (West Coast) hemlock, red gum, Douglas fir, sycamore, soft maple.

It requires 2 cords of the following: cedar, redwood, poplar, catalpa, cypress, basswood, spruce, white pine.

It has been determined that resinous woods such as the pines give a quicker and hotter fire, and are consumed much faster than birch. Birch gives a more intense flame and is consumed in a shorter time than oak, which gives a very steady heat. The resins in wood give twice as much heat as the actual substance, and hence resinous woods have more heating power per ton than nonresinous woods.

Should "Wood Waste" be Sold or Used as Fuel?

Many fabricators have used "wood waste" as fuel without a proper knowledge of its potential value. (See Plate XXIII.) The following illustration will serve as a guide for determining a definite means of estimating the value of nonutilized wood as a fuel. It has been estimated that "wood waste" material has a heat value of 5,000 British thermal units, while coal has a value of 14,000 British thermal units. Suppose a plant was paying $5.50 per ton for coal, what would be an equivalent value of "wood waste" material? Would it be more economical to purchase coal and sell "wood waste," or burn the "wood waste" for fuel purposes?

It will be seen that the heat value of wood is approximately $\frac{5}{14}$ of the heat value of coal. If coal costs $5.50 per ton, $\frac{5}{14}$ of $5.50, or $1.95, would indicate the fuel value of a ton of wood waste. However, if coal cost $11 per ton, this same waste would be worth $3.80 per ton.

If, then, a plant could rework the "wood waste" into other products, or could dispose of this material to other possible consumers at these prices (less the cost of handling, hogging, etc.), it would be more economical to buy coal for fuel.

Again, many fabricators do not know what "wood waste" for fuel actually costs them. It has been estimated by the Forest Products Laboratory that a thousand board feet of approximately 3,800 pounds of waste trim and cuttings, etc., from oak lumber, will have a fuel value equivalent to that of 2,360 pounds of coal. If coal is worth $6.50 per ton, the fuel value of a thousand board feet of oak would be $7.66. Often the actual cost of

lumber producing such waste would be $60.00 to $100.00 per thousand board feet, and the cost of such oak waste as fuel would be from eight to ten times that of coal, since handling charges in the furnace room are often greater for "wood waste" than for coal.

A careful check of actual conditions in the plant would determine whether wood waste is more economical to use than coal, and vice versa.

Some plants will find it advantageous to sell this material to other consumers who specialize in its use for fuel purposes, for example:

To large consumer power plants that use wood fuel

To merchants who recut the waste for household kindling wood

Remanufacture of Wood Waste Into Smaller Fabricated Articles

Multitudes of small fabricated products are possible through the remanufacture of various forms of waste cuttings, trimmings, and small blocks of wood. (See Plate XXIV.) Many unique novelties have been developed in this way at small cost.

These include small novelties, turned articles, etc. Following are a few suggested articles which can be turned from this material:

Axles
Balusters
Backmembers
Balls (float)
Bases, lamp
Beam barrels, warp, and yard
Bearing blocks, half round
Billiard cues, balls, etc.
Bracing
Broomstocks
Bungs
Brush blocks, shaped
Bushings
Candlesticks
Canes
Chair legs
Chess
Cleats
Clothespins
Cores, cylinders, etc.
Door knobs
Doorstops
Dowels, ½″ to 3″ diam.
Faucets
Floats
Handles
  baby carriage
  brush, many kinds
  car controller
  lawn mower
  tire pump
  tool
  whip
Mallets
Markers, road distance
Meat skewers
Molds, dipping
Newels, porch
Novelties
Novelty kitchen ware
  bread boards
  rolling pins
  small bowls
Pedestals, sundial, flower
Pegs, turned tent, etc.
Piano parts (valves, etc.)
Pickets
Pins
Pipe cleaners (fabricated)
Pipes, water, acid, mine culm
Plugs
Pipe bowls
Pole brackets
Poles, chicken roost
Porch columns
Pulleys
Quills, dogwood silk, etc.
Rails
Rods
Rolls and rollers
  adding machine
  braid
  casablancas
  conveyor
  insulator spacing
  lawn mower
  mangle
  map
  mine
  mop wringer

paper mill
player piano
textile mill
typewriter platen
window rollers
Rungs, hickory ladder
Shoe heels, last stock, etc.
Signs, stakes
Signs, street, name
Spool barrels, bored, shouldered
Spool middles, maple, basswood
Screens, wood slat
Spokes
Spools for wire, etc.
Spoons
Sporting goods
Sprags, mine
Stool legs
Toy parts
Tree nails
Trellis work
Trim (molding, turned and resawed)
Tubes
Tubing, conduit and chain pump
Turnings (many other kinds)

In every instance, fabricators have developed a definite product resulting from a study of market possibilities for these novelties. Often they are unit parts of another product.

Manufacture of Wood Pulp Products

The use of "wood waste" from both the mill and fabricating plant is increasing each year. In 1921 some 63,017 cords of mill "waste" was used for the manufacture of pulp and paper products. In 1927 it is estimated 266,608 cords were used. Authorities state that approximately 20 million cords of mill "waste" now exist at mills and plants.

In Europe the utilization of wood waste has been an established practice in the manufacture of pulp and in wood distillation. Many wood pulp mills are a unit of lumber producing mills, and are just as much a vital part in the industry as a planing mill or a box factory. Close utilization must be practiced because of the high price of stumpage and other manufacturing costs, and in order to produce a profit from the general operation.

At the present time the United States requires a total of 12,129,000 cords of wood pulp and pulpwood equivalents to supply its pulped products. Of this amount, 5,479,000 cords are produced in this country, and 6,862,000 cords are imported. The strange coincidence is that a large proportion of the imported wood pulp is produced from the "wood waste" of sawmills and wood working plants in other countries.

This country has awakened to the possibilities of using wood waste for pulp, as has been shown, by the increasing quantity of native "wood waste" being used each year. It is safe to predict that by 1950 one of the important sources of raw material will be "wood waste."

Southern mills producing kraft paper can readily use "wood waste." Such practice is now being established, and at one large plant the wood pulp mill already depends to a great extent on "wood waste" developed from its subsidiary wood-working plants. (See Plate XXV.)

The following information has been excerpted from Forest Products Laboratory Technical Note No. 204, *Commercial Processes of Pulping Woods for Paper:*

The commercial processes of making pulp from wood are the groundwood, sulphate, sulphite, and soda processes. The particular process used depends upon the grade of paper desired or the pulping characteristics of the various species of wood used.

The groundwood process produces a low-grade paper and is used in the manufacture of newsprint, cheap magazine paper, etc. The wood is mechanically ground into pulp and requires no chemicals in its reduction, and consequently this is a cheap method of reduction.

Only two or three woods are used, inasmuch as this method develops a low-grade pulp that is extremely weak and necessitates the use of those woods which have long, strong fibers. Balsam and spruce are adaptable for this use. Hardwoods are not generally adaptable for grinding and reduction.

In this process the color of the wood is reflected in the finished product; hence dark-colored woods, or those which contain pitch, knots, and decay would detract from the quality of the pulp and are not desirable. Quite often considerable quantities of longer- and stronger-fibered pulp are added in order to give the paper sufficient strength.

The sulphite, sulphate, and soda processes result in paper which is of a much stronger and better quality than that produced by the groundwood process. The chemicals used remove a large portion of the lignin, leaving fibers consisting almost entirely of pure cellulose. In these processes the chips are cooked with chemicals under steam pressure in a specially designed cooker or digester.

In the sulphite process calcium bisulphite formed by the action of sulphur dioxide gas upon lime is used. Certain grades of book, wrapping, bond, and tissue paper are produced from sulphite pulp. It is a little more expensive than the other processes, and the pulp yield is only about half as large as in the groundwood process. But the advantages are that the pulp is strong, and can be easily bleached to a high degree of whiteness. This process is used with such species as spruce, balsam and hemlock, or woods with long fibers, and with nonresinous softwoods.

The sulphate process is used in the manufacture of kraft or wrapping papers and high-test fiber boards. The chemicals used are mixtures of sodium hydroxide or caustic soda, and sodium sulphide. Since the process is alkaline, woods containing fats, resins, and waxes and other alkaline-soluble materials are suitable for reduction by this process.

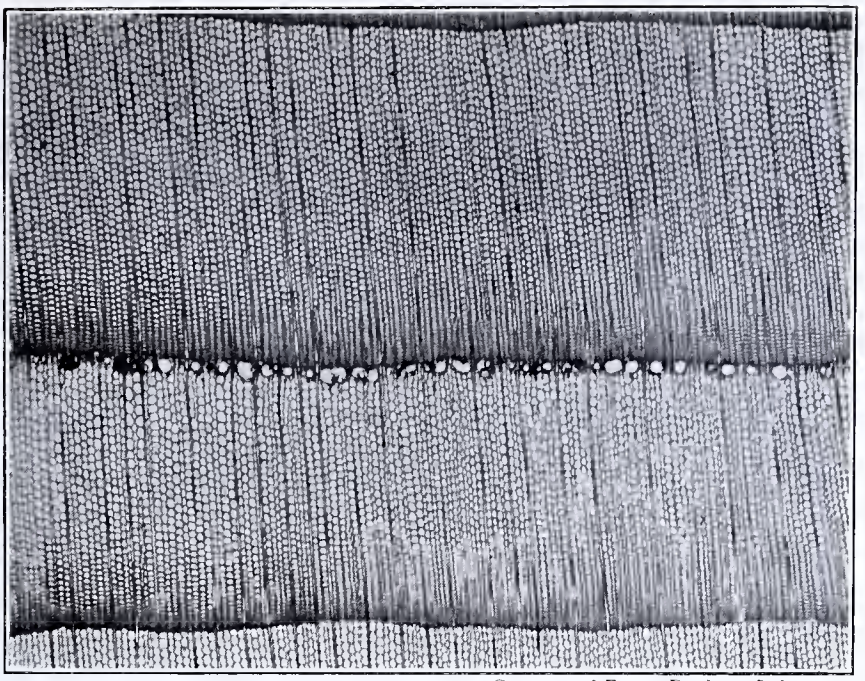
The resulting product is practically the same as from the sulphite process, and any long-fibered wood can be used.

Although sulphate pulp is generally used unbleached, the Forest Products Laboratory has recently discovered that it can be bleached by the two-stage method. This extends the use of the process to such woods as southern pine for the manufacture of high-grade book, magazine, and writing paper. Often book, lithograph, and envelope papers are made from a combination process in which a mixture of sulphite pulp and paper are made from the soda process. The resulting product is opaque, well felted, and well formed sheets of paper greatly favored by printers. Although any coniferous woods can be readily reduced by the sulphate process, it is particularly adaptable for use with soft, short-fibered, deciduous woods such as aspen, cottonwood, basswood, beech, birch, and gum. Soda pulp is sometimes used alone for cheaper, bulkier book paper, where strength is not essential. Caustic soda is the chemical used.

A newly developed (1929) process for pulping softwood and hardwood "waste" is especially adapted to the manufacture of corrugated board, wrapping paper, and wall board stock. It has been developed through research by the Forest Products Laboratory, where they are particularly interested in utilizing "wood waste" from little used species for a practical pulping process. Briefly the process consists of a combination chemical and mechanical method of conversion. The "wood waste" is chipped and treated with sodium sulphite and sodium bicarbonate under steam or hydrostatic pressure. The excess liquor is drawn off, the digester temperature is raised, and the final chemical action is completed by the reagents absorbed by and remaining in the chips. The wood is not, strictly speaking, reduced to a pulp, but consists of softened chips. Further reduction is made in the rod mill.

Unfortunately, no method of bleaching this pulp has been developed, and, therefore, the color of the wood shows in the finished product.

The process has been applied with commercial success to the conversion of wood pulp of spent chestnut chips after the tannin has been extracted. A high-grade corrugated board and wrapping paper are now being produced. The process is also adaptable to the manufacture of paper and insulating boards, and is of special value for its possibility in the utilization of wood waste occurring from the lesser used species.



Courtesy of Forest Products Laboratory

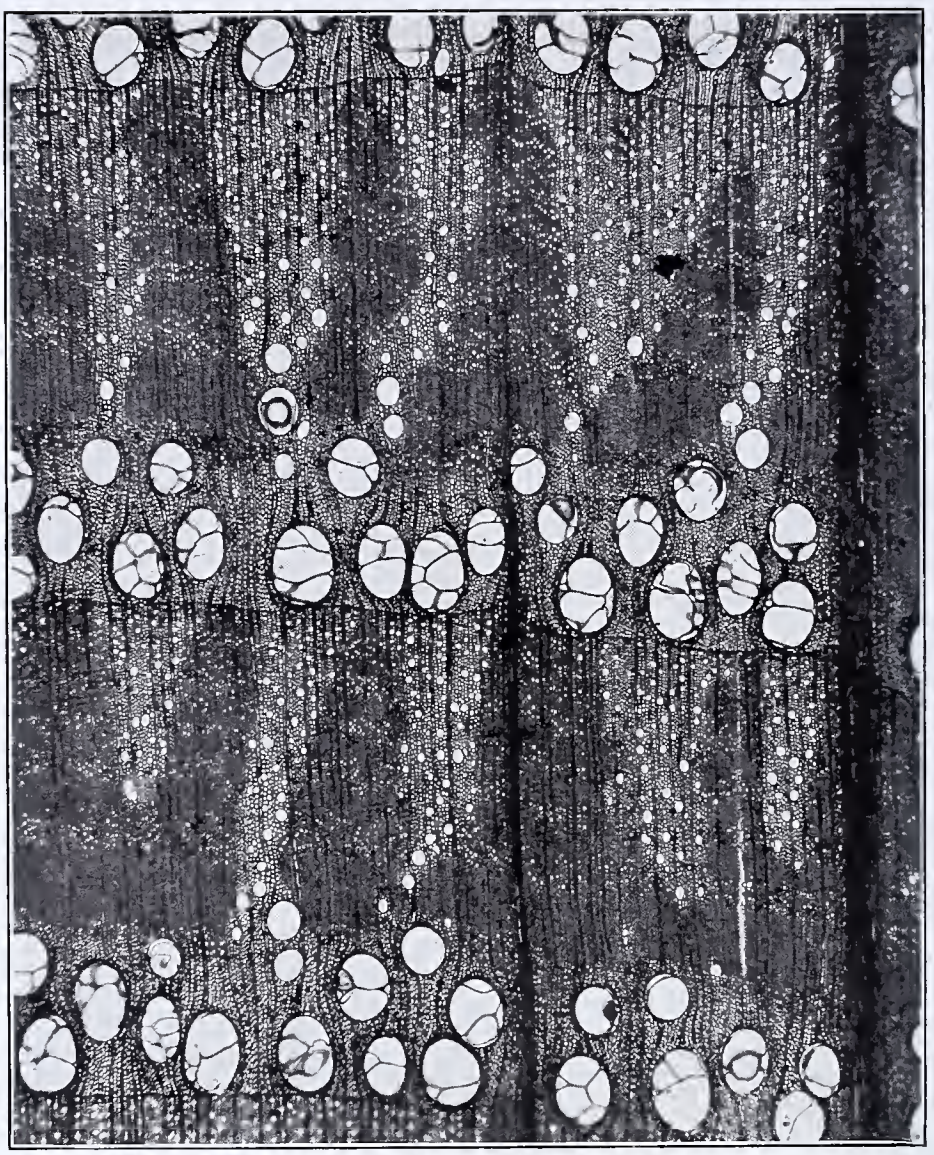
Plate XXVII—Cross-section of white fir magnified 20 times, showing typical traumatic resin canals. Note that they appear as round openings, forming a concentric ring at the termination of the annual growth ring.

A

B

Courtesy of Forest Products Laboratory

Plate XXVIII—Two pieces of pignut hickory depicting (A) a brash break and (B) a tough break. Note the fine splintering of the tough break, indicative of the resistance of fibers clinging together before finally tearing loose.



Courtesy of Forest Products Laboratory

Plate XXIX—Cross-section of white oak magnified 20 diameters, showing wavy, dark-colored, branched lines that extend into the summerwood, and pores containing tyloses, that appear as fine hair-like lines or strictures. Note also the wide, dark-colored wood ray at the right.

American Woods for Paper Making [1]

The following is a summary of the pulping qualities of the principal commercial woods of the United States. Only five or six of these woods now find extensive use in the pulp and paper industry, but laboratory tests indicate that with slight modifications in the standard pulping processes many others might be used in the manufacture of commercial grades of paper.

Softwoods

SPRUCES

All spruces are suitable for pulping by any process. All make high quality pulp.

HEMLOCKS

Western hemlock is very similar to spruce in its pulping qualities, although in the groundwood or mechanical pulping process it requires more power to yield pulp of the same strength. Eastern hemlock is not so suitable for groundwood, and chemical pulps from it are darker, require more bleach, and are usually weaker than spruce pulps.

FIRS

All true firs are suitable for pulping by any process. Red fir gives rather dark sulphite and mechanical pulps, and its sulphate is more difficult to bleach than is spruce sulphate. The other firs are as readily pulped by any process as is spruce, and the pulps obtained are comparable to spruce pulps.

PINES

Lodgepole, western yellow, white, sugar, limber, and piñon pines all make good mechanical pulps. The other pines tested are too dark or contain too much pitch to be well suited to the groundwood process. Jack, loblolly, lodgepole, Norway, pond, sash, and scrub pines, by slight modifications of the cooking process, can be made into good sulphite pulp with reasonable bleach consumption. With the other pines, uniformity of digestion is more of a problem. All other pines reduce readily in the alkaline (soda and sulphate) processes, and all bleach satisfactorily under proper conditions.

CYPRESS, DOUGLAS FIR, LARCHES, REDWOOD, AND RED CEDARS

None of these are suitable for groundwood. They are much more difficult to pulp by the sulphite process than hemlock, and the bleach consumption is barely within the range of commercial feasibility. All of them may be reduced by alkaline processes to pulps not quite so strong as but otherwise comparable to pine pulps. Redwood and the red cedars are too light in weight to make their use practical.

WHITE CEDARS

White cedars reduce readily by all processes. The pulp yield per cord of wood is very small, however, since it is proportional to the weight of the wood. As pulpwood is bought on a cord basis, the white cedars probably would not prove acceptable to the industry.

Hardwoods

MECHANICAL PROCESS

Hardwoods are not specially adapted to the profitable manufacture of mechanical pulp, because so much power is required to grind them.

SODA

All hardwoods can be reduced by the soda process, and the pulp can be used in conjunction with spruce sulphite or some other long fibered stock in the manufacture of book and similar grades of paper. Basswood and aspen are among the hardwoods most easily pulped. Red alder, balsa, chestnut (after tannin extraction), elms, soft maples, and willows all pulp rather easily. Ash, birches, beech, buckeye, butternut, catalpa, gums, hackberry, magnolias, mangrove, and hard maples are rather

[1] Technical Note No. 212—Forest Products Laboratory.

difficult to pulp, but some of them are used commercially. Hickory, locust, oaks, and sassafras are difficult to pulp, and their use is generally impractical.

SULPHITE

Some of the hardwoods can be readily pulped by the sulphite process and made into book and similar grades of paper with small bleach consumption. Among them are ash, aspen, birches, butternut, most elms, gums, hackberry, hickory, magnolias, maples, sycamore, and willow. Hardwoods that are difficult to pulp by the sulphite process because of structural irregularities or the presence of extractive materials, are basswood, buckeye, catalpa, chestnut, locust, oaks, red gum, sassafras, and slippery elm.

Recent trials at the Forest Products Laboratory give promise that a number of hardwoods, including aspen, beech, birch, cottonwood, black gum, tupelo gum, maple, and other light-colored woods, can be reduced by a combination of chemical and mechanical processes to a pulp well suited for the manufacture of the lower grades of print paper.

Possible Uses of "Wood Waste" in the Manufacture of Pulp and Paper Products

The use of "wood waste" for the manufacture of pulped products is in its infancy. At the present time one of its most important uses is for the manufacture of wood fiber insulating boards and other products. The importance of these products is spreading as new uses for them are being developed. Wood fiber insulating board is giving most satisfactory service to users.

Southern pines, Douglas fir, red gum, etc., are generally preferred for insulating board manufacture. The fundamental success of their use for this purpose is due to the economical pulping and subsequent low manufacturing cost incident to their fabrication.

Within the last few years several types of insulating boards have been developed and have met with success in the trade.

A thorough analysis of the economical advantages of the use of "wood waste" as a raw material for the manufacture of insulating boards has recently developed plants which depend largely on this type of material. The future of the insulating board industry will depend to a large extent upon the available supply of potential wood waste.

Other possible uses for pulped products are in the form of containers, toys, novelty products, boxes, etc. A more detailed list follows:

Bag specialties
Bottle tops
Candy boxes
Containers
Corrugated products
Dishes
Dolls and toys
Egg cartons
Electrical twine and cord
Flower pots
Folders
Food containers
Insulating boards
Lamp-shade novelties
Mailing tubes
Mats and rugs
Models
Mothproof bags
Napkins
Oiled lard bags
Paper
Paper excelsior
Picture frames
Pie plates
Playing cards
Shipping cases
Spoons
Stencil boards
Sulphurized paper products
Trays
Trunks
Wastebaskets

Use of "Wood Waste" for Distillation Purposes

Unfortunately, the wood distillation industry has met with serious difficulties that for a time threatened it. A steadily decreasing demand for various wood distillation products has been evident for some time. The chief reason for this decline was due to the manufacture of synthetic products identical with those produced from the distillation of wood.

The hardwood destructive distillation group suddenly found itself competing with synthetic methanol, produced at a cheaper cost in manufacture than the wood product. Acetic acid, one of the most important products of the wood distillation industry, was produced from carbide.

In order to compete with these products it became evident that drastic changes were necessary in the wood distillation industry. In the past, the industry depended on standing timber for its raw material. But stumpage values have increased, and the wood distillers, becoming aware of the possibilities of utilizing "wood waste" as developed in Europe, now realize that the future supply of raw material for distillation purposes will depend on "wood waste."

Numerous manufacturing details were perfected which radically changed and affected manufacturing costs, and as a result the industry today is assured of continued progress and success.

A study of existing conditions also indicated that successful wood distillation practice would depend upon large, well equipped, and efficiently operated plants, instead of small units. In Europe wood chemical plants are operated in conjunction with large sawmills or woodworking plants, which utilize the "wood waste" developed at these plants.

Two distinct methods of wood distillation are now in use, which depend to a large extent upon the species used; i.e., hardwoods or softwoods.

Destructive Distillation (used for hardwoods and softwoods)

HARDWOODS: Principal products derived

- Pyroligneous acid
  - acetate of lime
    - acetone
    - acetic acids
  - methanol (wood alcohol)
  - and many complex products
- Charcoal
- Wood tars, etc. (creosotes)
- Wood gas

SOFTWOODS: Principal products derived

- Pyroligneous acid (of little importance)
- Crude tar (tar)
  - pine tar oils (wood creosotes)
  - turpentines
    - pine oils
  - Pitch
  - Charcoal

Steam or Solvent Distillation

This process is confined to resinous woods. It is well adapted to light wood (fat pine), stumps, "wood waste," and even sawdust. The process consists in hogging the wood and subjecting it to steam treatment. This removes the crude turpentine and pine oils. The resulting wood chips are dried. Recently a use has been found for these chips for pulping in the manufacture of kraft paper.

The solvent process consists of treating the wood in retorts with a solvent, such as naphtha, benzol, etc., after the preliminary extraction process. The solvent removes the rosin from the wood. The remaining solvents are recovered by fractural distillation and the extracted chips are used for fuel or pulping purposes.

The principal products derived are:

Resinous wood:

- Steam Extraction Process
  - Chips subjected to *steam* treatment
    - crude turpentines (steam distilled turpentines)
    - pine oils
      - various pine oils
- Solvent Process
  - Chips subject to a solvent
    - crude rosins and pine oils
      - refined pine oils
      - rosins
    - extracted chips

Manufacture of Rayon (Artificial Silk) from Wood

It has been estimated that approximately 85 per cent, or more, of the rayon produced in 1929 was manufactured by the viscose process, in which wood pulp is the chief raw material. The rayon industry has grown by leaps and bounds in the last few years, and it has further possibilities of tremendous expansion.

In the viscose process high-grade bleached sulphite from spruce is used. Research indicates that other species, such as balsam fir, tamarack, hemlock, or any pure coniferous pulp, can be used.

It is estimated that a ton of bleached sulphite pulp will make 1500 pounds of rayon.

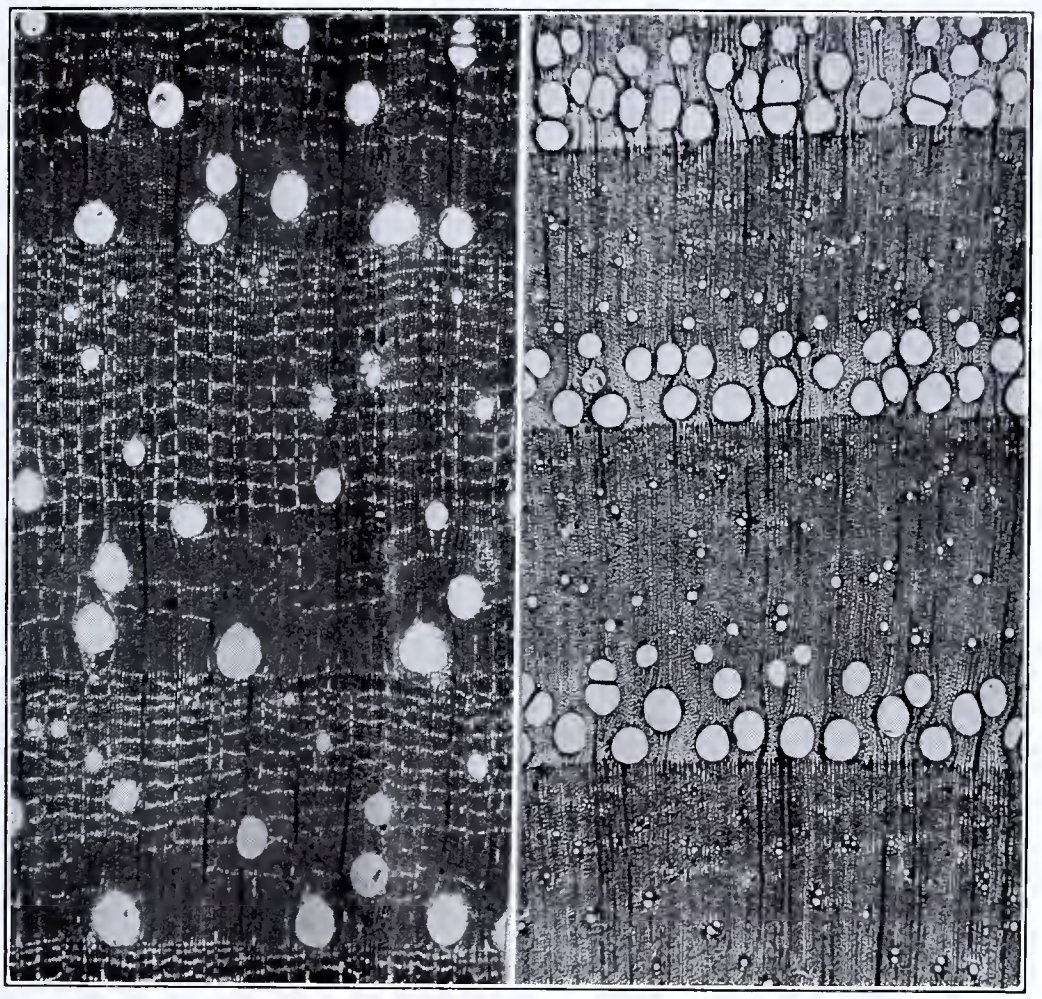
It can be readily seen that the rayon industry offers still another opportunity for the utilization of "wood waste." Due to the increasing cost of standing timber it is logical to assume that the rayon industry will depend more and more upon "wood waste" for its supply of raw material.

Suggested Uses for Various Kinds of Wood Waste

The following list indicates a few of the many uses for various forms of wood waste, other than those discussed:

Sawdust

- An absorbent
  - Butcher shops
  - Markets
  - Packing houses
  - Currying animals
  - Kennel bedding
- Cleaning (drying and polishing)
  - Aluminum utensils
  - Metal products
  - Tubing
  - Wire novelties
- Composition products
  - Artificial wood
  - Cast products
  - Clay products
  - Composition flooring
  - Concrete roof tiles, slabs
  - Concrete products
  - Floors (for sound deadening)
  - Gypsum compositions
  - Molded articles
  - Plaster boards
  - Stucco and plasters
- Fuel
  - At points of production (sawmills, factories, etc.)
- Briquettes
- Domestic purposes
- Gas products
- Steamboat use

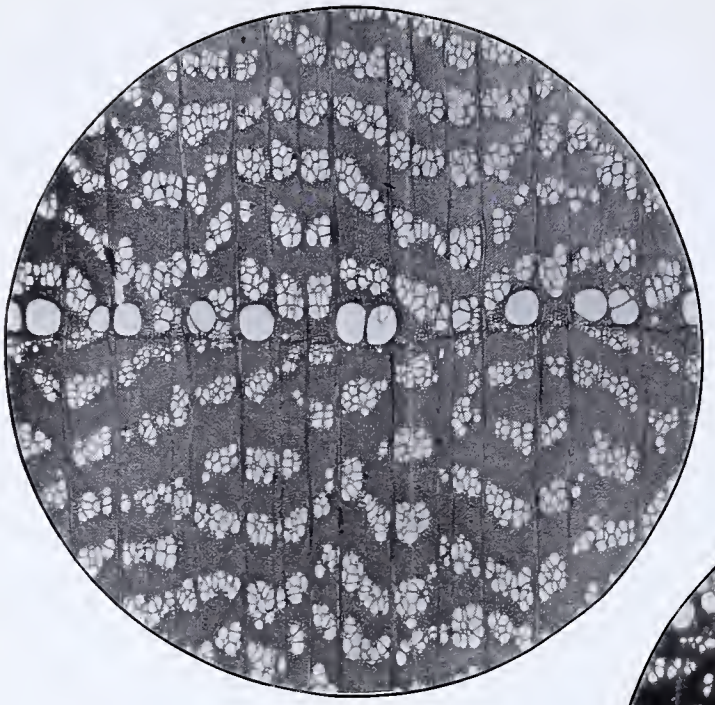


Courtesy of Forest Products Laboratory

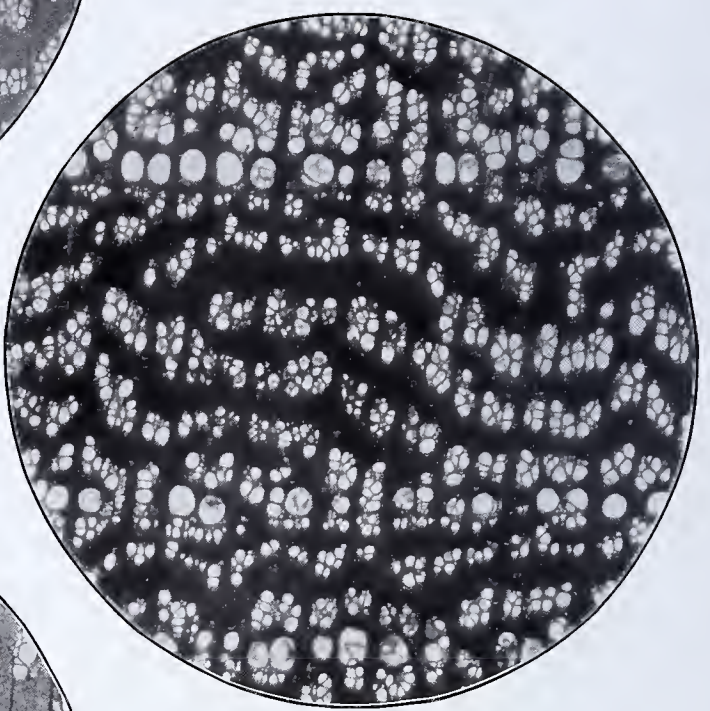
A B

Plate XXX—A cross-section of (A) pignut hickory and (B) white ash, magnified 20 diameters, showing parenchyma tissue. In the hickory it will be noted that fine, light-colored lines of parenchyma in the summerwood are arranged in tangential lines that do not surround the pores.

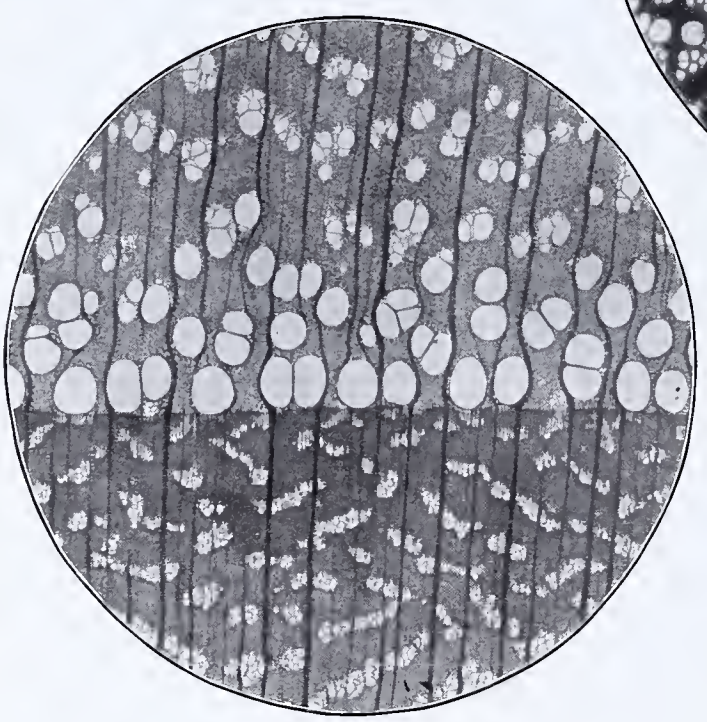
In the ash the parenchyma is arranged tangentially, and appears as waving, light-colored bands which embrace the pores. Note also how many of these summerwood pores are arranged in radial rows consisting of from two to three pores.



A



B



C

Courtesy of Forest Products Laboratory

Plate XXXI—Cross-section of (A) white elm, (B) rock elm, (C) slippery elm, magnified 20 times. Note that in white elm the springwood pores are arranged in a single row, and about equal in size. Rock elm exhibits a single row of pores that vary in size. In the slippery elm there are several rows. The small summerwood pores are joined in wavy, tangential bands. It is this formation which gives elm a characteristic wavy appearance, particularly in the summerwood, and is seen in cross-section with the naked eye.

- Heat insulation
  - Cars
  - Ice houses
  - Homes
- Miscellaneous
  - Canning extracts
  - Carborundum and calcium carbide
  - Chemical purposes
  - Cleaning and dressing furs
  - Coloring clay pipes
  - Distillation
  - Dye production
  - Ethyl alcohol
  - Extraction
  - Fertilizer
  - Fireworks
  - Floor-sweeping compounds
  - Gas purification
  - Hand soaps
  - Hardening and annealing of metals
  - Leather industry
  - Lettering and decorating
  - Lime burning
  - Meat smoking
  - Medicinal uses
  - Nursery practice
  - Oil-fire extinguisher
  - Oxalic acid
  - Protection of freshly poured concrete
  - Roofing paper
  - Railroad signal rockets
  - Wall paper
  - Waterproofing mixtures
  - Wood flour
  - Wood meal fodders
- Packing
  - Grapes and fruit
  - Ice
  - Miscellaneous products

Wood Flour or Sander Dust

- Composition flooring
- Filler
  - Dynamite cartridges
  - Dolls, etc.
- Linoleum
- Phenol resin products (Bakelite)
- Wall paper
- Wood plastics
  - Artificial carvings
  - Buttons
  - Furniture turnings, etc.

Bark

- Tannins
  - Chestnut
  - Hemlock
  - Tan bark oak

Wood Waste (edgings, trimmings, etc.)

- Brace blocks
- Excelsior
- Novelties
- Toys
- Turned products

Wood Distillation Products

- Uses for derived products
- Hardwoods
  - Charcoal
    - Blast furnaces for charcoal iron
    - Casehardening and forging
    - Electric melting
    - Metallurgical industry and smelters
    - Electrodes and resistances
    - Insulation in refrigerating industry
    - Gasoline refining
    - Black powder
    - Drugs and medicines
    - Laboratory and research work
    - Production of calcium carbide and cyanide
    - Sugar refining
    - Candy and sirup manufacture
    - Manufacture of glucose, table oils, gelatine
    - Glue, cream of tartar, alcohol, and lithopone
    - Fruit canning industry
    - As an absorbent base for fertilizers
    - Poultry and cattle food
    - Filtration and gas absorption
    - Decolorizers and deodorizers
    - Restaurant and dining car fuel
    - Domestic fuel, heaters, etc.

Fuel for gas producers, water gas generation
Briquetting
Colloidal fuel
Acetic acid
Preparation of various inorganic acetates: lead, copper, sodium, etc.
Cellulose acetate
Organic acetates (used as solvents)
Enters into manufacture of indigo, salvarsan
Dyeing purposes
Use in laundries
Tanning
Insecticides
Soaps
Toilet articles,
Chrome yellow, etc.
Coagulating latex
Acetone
Solvent
Smokeless powder
Acetylene
Chloroform and iodoform
Wood alcohol
Solvent in varnishes and lacquers
Formaldehyde
Anti-freeze solutions
In preparation of dyes of the methyl group
Wood tars and oils
Preparation of rubber
Electrical insulations
Flotation oils for mineral separation
Medicinal disinfectants
Shingle stains and paints (color carriers)
Preservatives
Insulating pitches
Medicinal creosotes
Softwood Distillation Products
Turpentine [1]
Volatile thinner for paints, varnishes and wood fillers
To accelerate oxidation of drying oils (as an ozonizer)
Solvent for waxes in shoe and leather polishes, floor polishes and furniture polishes
Solvent for gums in lacquers and varnishes
Ingredients of waterproof cements for leather, rubber, glass, metals, etc.
Solvent for waterproofing compositions

[1] "Leather and Paper Laboratory of the Bureau of Chemistry"—*Naval Stores Review*, April 27, 1917.

Cleaner for removing paints and oils from fabrics
Pharmaceutical purposes, including:
disinfectants
internal remedies
liniments
ointments
medicated soaps

Rosin[1]
Manufacture of rosin soaps, including
laundry soaps and soap powders
sizing of paper and paper board
paint dryers
axle grease
waterproofing compounds (insoluble rosin soaps)
emulsifiable oils (lubricants for high-speed tool work)
leather dressings and shoe polishes
enamels used in ceramics
Manufacture of certain volatiles and lacquers
Manufacture of plastic compositions, including
sealing waxes
cores for foundry work
rubber substitutes
shoemakers' wax
briquettes and fire kindlers
artificial wood
composition for pattern making
papier-maché
brewers' pitch
roofing cement
grafting wax for trees
cheap linoleum and oilcloth
in shoe-bottom fillers
lutes
Pharmaceutical purposes, including
ointments
plasters
cerates
internal remedies (veterinary)
disinfecting compounds
Making roofing materials
Adulteration of ceresin and paraffin waxes
Adulteration of beeswax and "artificial beeswax"
Adulteration of shellac and certain resins
Manufacture of Venice turpentine substitute
Flux for soldering and tin-plating
Dusting molds in foundries
In dry batteries and electrical insulation

[1] "Leather and Paper Laboratory of the Bureau of Chemistry"—*Naval Stores Review*, April 27, 1917.

Constituent of wood stains
In belting grease
On leather belts to prevent slipping (use inadvisable)
On violin bows
For setting bristles in hairbrushes
Constituent of insect powders
For the manufacture of "artificial copal"
In steel hardening
Constituent for enamel for brick walls
Raw materials for producing synthetic camphor
(and indirectly)

celluloid	fireworks
explosives	medicines

Raw material for producing terpineol and eucalpytol
Raw material for producing terpinhydrate used in medicines
Raw material for producing isoprene used in making synthetic rubber
In the manufacture of sealing wax
In glazing putty
Ingredients of some printer's inks
In color printing processes in lithography
Lubricant in grinding and drilling glass
As a moth repellant, and in moth exterminators
Constituent of insecticides
For cleaning firearms
In laundry glosses
In washing preparations
In rubber substitutes
In wood stains
In stove polishes
In modeling waxes and grafting waxes
In belting greases
In drawing crayons
In the manufacture of patent leathers
As a substitute for pine oil in flotation, concentration of ores
Solvent for rubber, caoutchouc, and similar substances
Used to prevent "bleeding"
In the manufacture of cotton and woolen print goods
Laboratory reagent as substitute for more expensive organic solvents
Oxygen carrier in refining petroleum illuminating oils
Colored turpentine, reagent for wood and cork in biological technic
Coating for match splints
Constituent for some floor waxes and polishes
In wax tapers
Hardening tallow candles
In stamping powders

Sizing for wood pulp—wallboard
In waterproofing composition for paper
Cardboard and fabrics
Paper hangers' size
Making imitation Burgundy pitch
Manufacture of munitions (filling vacuum space in shrapnel)
Manufacture of sticky fly-paper
Constituent of sweeping compounds
Waterproofing wooden fence posts
In mixtures to protect trees from climbing insects
Constituent of printing inks
In cements
For caulking ships
In sulphite-waste utilization (Trippe process)
In the manufacture of condensation products
As a raw material for producing certain chemicals (benzine derivatives)
In the manufacture of carborundum and calcium carbide (using sawdust and refuse wood chips with residues from the manufacture of turpentine and rosin)
In destructive distillation to produce rosin oil and rosin oil products used in
    cements
    lubricants (oils and axle grease)
    printing inks
    adulterating linseed oil
    brewers' pitch
    varnishes
    rubber substitutes
    funnel paints for yachts
    flotation concentration of ore
    mixtures to protect trees from climbing insects
    shingle stains
    waterproofing textiles and cordage
    manufacture of lamp black
    for lithographic purposes
    soap making
    leather dressing and shoe polishes
    sweeping compounds
    adulterating olive oil and castor oil
    rosin spirits used in
        illuminants
        turpentine substitutes
        cheap varnishes
  acetic acid used for making
    acetate of lime
    acetate of iron (mordant and mineral dye)
    acetate of alumina (waterproofing cloth)

pitch used for
- cobblers' wax
- preserving cordage and nets
- roofing felts and waterproofing papers
- bituminous paints
- binder and briquettes
- caulking ships
- cements, lutes
- electrical insulation
- plastics for pattern making
- grafting wax for trees
- paving material
- steel hardening compositions
- waterproof masonry

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No. 274—*Forest Products in the Chemical Industries.*
No. 738—*Hardwood Distillation Industry.*
No. 560—*Lightwood, Cut-over Lands, and the Naval Stores Industry.*
No. 668—*Manufacture of Ethyl Alochol from Wood Waste.*
No. 117—*Wood Waste as Gas Producer Fuel.*
No. 512—*Use of Wood in Chemical Apparatus.*
No. 238—*List of Publications on Derived Products.*

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(See general list of Associations, general Bibliography, and general list of Periodicals for publishers' addresses.)

THE IDENTIFICATION OF WOOD

Many a car door is opened and after the first few boards have been pulled loose a suspicion develops in the mind of the purchaser or consumer that something is wrong. Why?

Each year thousands of samples of wood are sent to wood technologists for examination and identification. Why?

Wood is sometimes difficult to identify as to species. Its structure varies and often a wide range of physical properties is found even within a species. For this reason many consumers doubt whether the shipments received are of the species ordered.

The first step towards eliminating doubt in the mind of the purchaser or consumer as to whether he will receive the species ordered, is to specify definitely and accurately *on the order* the exact species required, since manufacturers and distributors of reputable standing make every effort to ship lumber and stock exactly as specified.

Secondly, specify *on the order* the commercial name of the species desired, using that which is in accordance with American Lumber Standards.

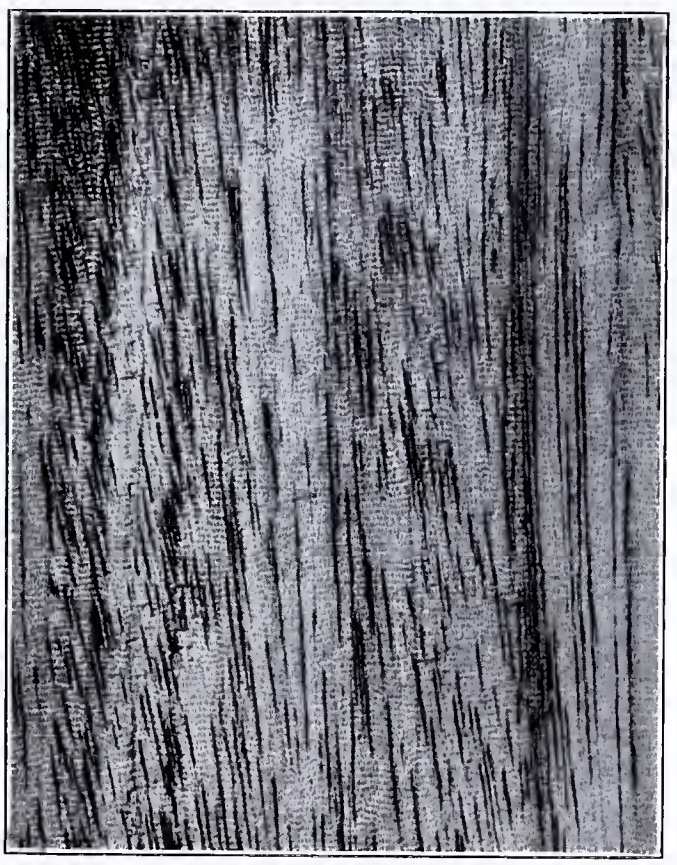
While it is true that lumber often is mixed at the mill through improper handling and piling methods, it should also be borne in mind that each outgoing shipment usually is loaded and tallied by an experienced lumber inspector. It is the unintentional mixing of species, or stock shipped from nonreputable mills or distributors, that causes trouble through suspicion on the part of the consumer that species have been misrepresented.

Wood is identified by two distinct types of separation. First, by scientific examination of thinly cut sections through a microscope, which clearly shows the various features of the wood structure and accurately identifies the species. Wood identification to the expert technologist is simply a matter of study and research.

The other method of identifying wood is simply through personal judgment based on long handling experience. The lumber inspector bases his identification of a species on long contact and constant association with various species. This is the practical method of identifying wood; often it may be wrong. Such procedure is governed by the color, weight, feel, general features, and characteristics of the grain and figure, the appearance of the board as a whole, etc.

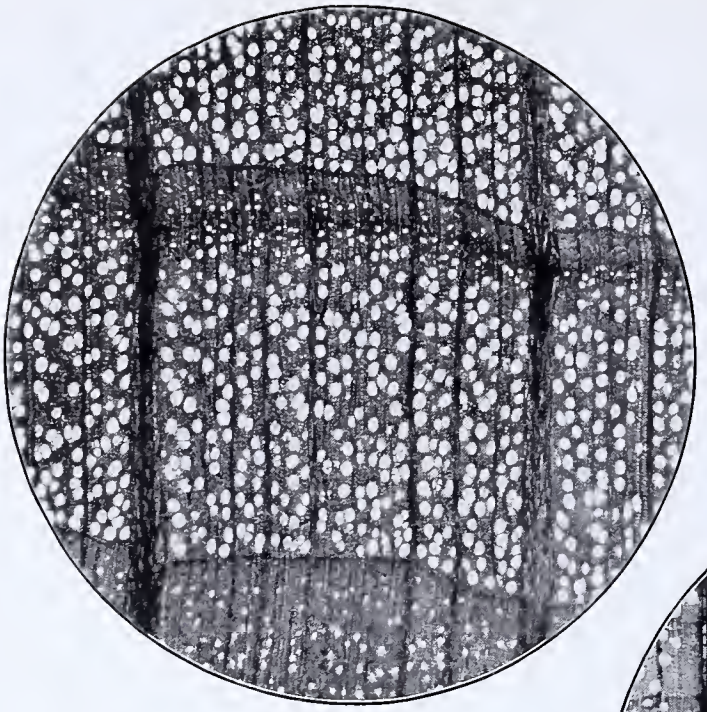
Accurate identification, therefore, is based upon the microscopic examination of the structure of the wood. On the other hand the layman, or the average purchaser or consumer, is not expected to have a scientific knowledge of wood structure. This entirely eliminates the possibility of microscopic identification by the layman or average consumer. It is, however, most imperative for him to have a knowledge of a few simple features of wood.

A definite and accurate means of identifying wood by its gross features is difficult to develop. There have been worked up, however, classifications and systems referred to as "keys" for tracing wood species, which in a general way serve the purpose. These have been developed with the idea of giving the average consumer a simple method of distinguishing wood species. In every instance the keys require a knowledge of a few simple fundamentals in wood structure that are easily observed with the naked eye.



Courtesy of Forest Products Laboratory

Plate XXXII—Tangential section of true mahogany showing the rays which are called ripple marks. In reality, they appear as more or less horizontal rows, or stories (natural size).



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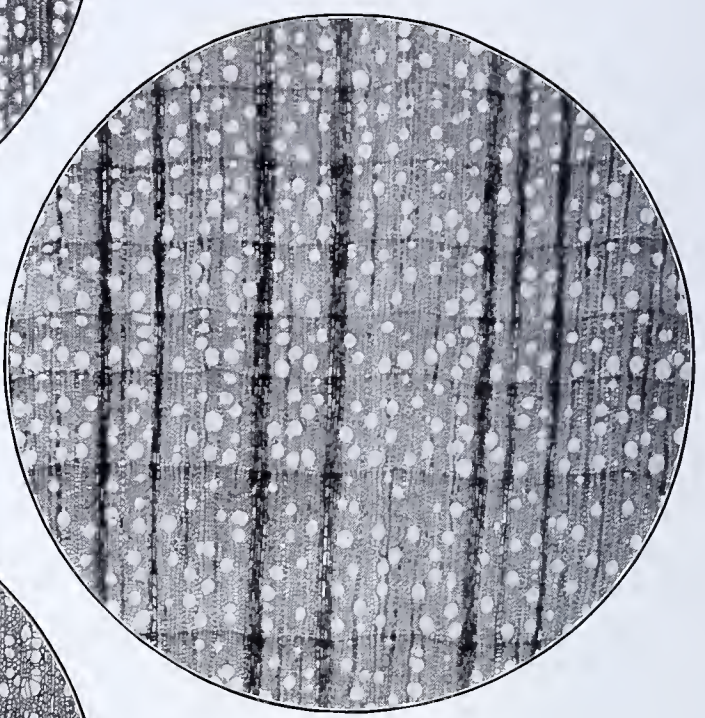

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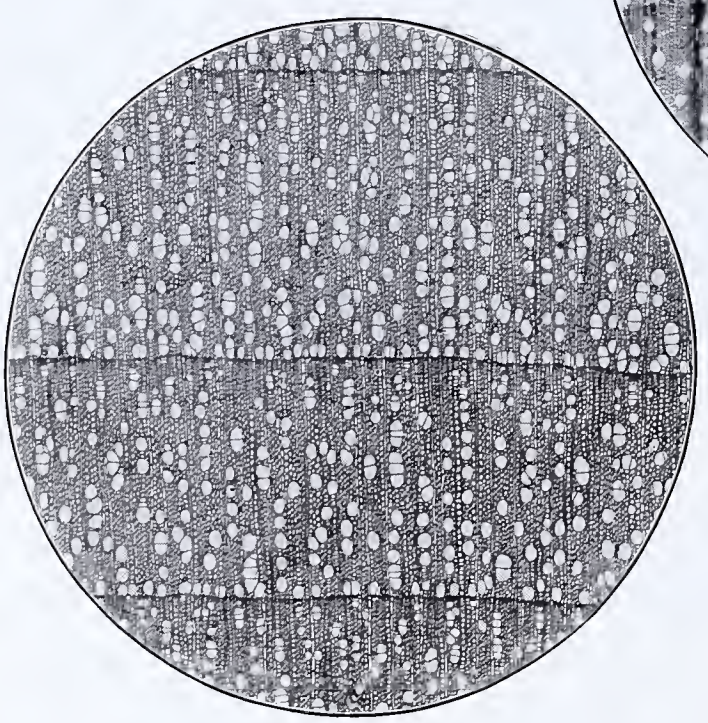

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Courtesy of Forest Products Laboratory

Plate XXXIII—Cross-section of (A) beech, (B) dogwood, (C) tupelo gum, magnified 20 times, depicting variations in the size of the wood rays. (Refer to key classification 31A, 31B, 31C.)

Note in beech the extremely dark, large rays between which are finer, smaller rays.

In the dogwood the rays are narrow but quite distinct, and are about as wide as largest pores, parenchyma is barely visible.

In the tupelo gum it requires careful examination to pick out the fine, light-colored wood rays. They are much narrower than the small, minute pores, even under the lens.

Many individuals have found the method of comparing a known to an unknown species to be of value. Sample blocks of wood, of average structure, cut from a definite species, are procurable from many of the forest schools, lumber associations, etc. This method has its real value only in comparison of the actual appearance of the wood, rather than fundamental structural features, and will be found to be of most value if used in conjunction with the key.

At the end of this chapter is shown a simple and effective diagrammatic key which is intended as a guide in the separation of the more important commercial woods used in construction and industrial fabrication. Its only drawback is the need for experience and familiarity with its operation. Several attempts at using it, together with a little study, will develop a deftness that will result in an easy and effective method of identifying wood.

It is not infallible, since wood structure often varies. In general, it is built upon variations in the cross-sectional appearance of the wood. The following points refer to the use of the key:

Only such technical terms have been used in the key as are required in its successful operation

It covers commercially important softwood and hardwood species

"General description" refers to cross-sectional appearance, but often radial and tangential surfaces are also required

The ordinary pocket lens, magnifying 6 to 10 times, or a better one magnifying 15 to 20 times, will aid in showing clearer details of the structure

In working with the key, obtain a good-sized sample, preferably one showing plenty of surface, and containing both heartwood and sapwood

Cut the block so as to expose cross, radial, and tangential surfaces

A cross section or end surface of wood is developed by cutting at right angles to the grain of the wood

A radial (quarter-sawed, rift-sawed) section is developed by cutting *parallel* to wood rays (see Illustration 11)

A tangential (plain-sawed) section is made by cutting at right angles to the wood rays

Clean, unstained, and unmarred surfaces are required

The details of a smoothly-cut section without torn grain can be sharply brought out by adding a drop of water to the surface

Color descriptions refer to the general color or cast of the wood as viewed in a longitudinal section

Steps in Using the Identification Key

Below are shown three tables which assist to a great extent in pointing out striking variations in the color of the heartwood, the relative weights, and the hardness and softness of both hardwood and softwood species.

In every instance it would be wise to refer to the discussion given under "Description" in the chapters on each species so as to pick up other outstanding features covering wood structure which are there explained in greater detail.

If possible, work with a known set of samples.

Note that key has been arranged on one side of the page, and opposite are described in detail the terms, nomenclature, and other distinctive identifying marks that simplify its operation. Study with a little patience the illustrations of wood structure, which present

more clearly the fundamentals of wood structure. A little patience is well worth while before attempting to use the key. Remember that wood technologists have devoted a lifetime to the peculiarities and complexities of wood structure, and even then they have many things to learn.

Color Classification of Wood Species

The following table briefly summarizes different ranges in the color of the *heartwood* of the more important commercial species of wood. It is practically impossible to accurately describe the color of wood, due to wide variations caused primarily by growth and site

TABLE 25

Color Description	*Hardwoods*
White	Buckeye
Creamy white	Basswood
Creamy white (slight yellow cast)	Magnolia
Silvery-brown	Ash
Light grayish-brown	Elm, soft
	Gum, tupelo
	Cottonwood
Grayish-brown	Oak, white
Light yellowish-brown	Gum, black
Yellowish-brown (green tinge)	Poplar, yellow
Light brown (tinged with pink)	Dogwood
Light brown (tinged with red)	Elm, rock
Light reddish-brown	Alder
	Beech
	Birch
	Maple, silver
	Maple, red
	Maple, hard (sapwood white)
	Hickory, true
Reddish-brown	Cherry
Brown (tinged with red)	Sycamore
Dark yellowish-brown	Chestnut
Dark brown (decided red cast)	Gum, red
Deep reddish-brown	Mahogany
Light chocolate-brown	Butternut
	Elm, slippery
Dark brown	Persimmon (sapwood light brown)
Deep chocolate-brown	Walnut
	Softwoods
White	Spruce, eastern
Creamy-white	Pine, sugar
Creamy-white (yellow cast)	Cedar, Port Orford
	Pine, Pondosa
Pinkish-white	Pine, northern white
Deep pinkish-white	Pine, Idaho white
Light silver gray (brown tinge)	Spruce, Sitka
Pale yellow (red tinge)	Spruce, Engelmann
Pale brownish-yellow (red tinge)	Hemlock, West Coast
Yellow (bright clear)	Cedar, Alaska
Light yellowish-brown	Cedar, northern white
Light brown (yellow tinge)	Tamarack, eastern
Light brown	Hemlock, eastern
Light brown (red tinge)	Cedar, southern white
Pale reddish-brown	Cedar, incense
Brown to reddish-brown	Pine, southern yellow
Slight red to dark brown	Cypress, red
Reddish-brown (decided red tinge)	Larch, western
Reddish-brown to dark brown	Cedar, western red
Orange to deep red	Fir, Douglas
Deep clear red (variegated)	Cedar, eastern red
Deep reddish-brown (sometimes light red)	Redwood

conditions which are bound to occur, particularly where a species is scattered over a large range. The table is intended as a short-cut method in identifying various species of wood when used in conjunction with the key, found at the end of this chapter. It will be noted that the hardwoods and softwoods have been arranged to fall in a color range between cream and deep chocolate-brown or reddish-brown. An attempt has been made to classify the species as much as possible by the increasing deepening of their respective colors.

Weight Classification of Important Commercial Wood Species

The following table, as nearly as possible, classifies in a definite range the weights of the more important commercial species of wood. It indicates the gradation, by weight, of the lightest to the heaviest woods.

Weights, as indicated for these species, represent their calculated specific gravity based upon their volume when green, and weight when oven-dried.

TABLE 26

WEIGHT CLASSIFICATION OF WOOD SPECIES

Weight Description	*Hardwoods*	*Softwoods*
Extremely light	Balsa	None
Very, very light		None
Very light to Light		Cedar, northern white Cedar, western red Spruce, Engelmann
Light to Moderately light	Basswood Buckeye Butternut Alder, red Cottonwood	Spruce, Sitka Cedar, incense Pine, sugar Pine, northern white Spruce, eastern white Hemlock, eastern
Moderately light to Moderately heavy	Poplar, yellow Chestnut Elm, white Gum, red Maple, silver Ash, black Magnolia Gum, black Gum, tupelo Sycamore	Hemlock, west coast Pine, Pondosa Spruce, eastern red Pine, Idaho white Cedar, Alaska Cedar, Port Orford Cypress, red Redwood Pine, Norway Fir, Douglas
Moderately heavy to Heavy	Cherry, black Elm, slippery Maple, red Walnut, black Ash, green Ash, white Beech	Pine, pitch Larch, western Tamarack, eastern Pine, loblolly Pine, pond Pine, shortleaf
Heavy to Very heavy	Birch, yellow Maple, sugar Oaks, red Elm, red Mahogany (true)	Pine, longleaf Pine, slash
Very heavy to Extremely heavy	Hickories (true) Oak, white Dogwood Persimmon Hickory, pignut Oak, live	None
Extremely heavy	Lignum vitæ	None

The relative interpretation of this table is based on average specimens of wood; wide variations, however, may occur in any species. Weight terms as shown are used in the key.

Hardness Classification of Important Commercial Species of Wood

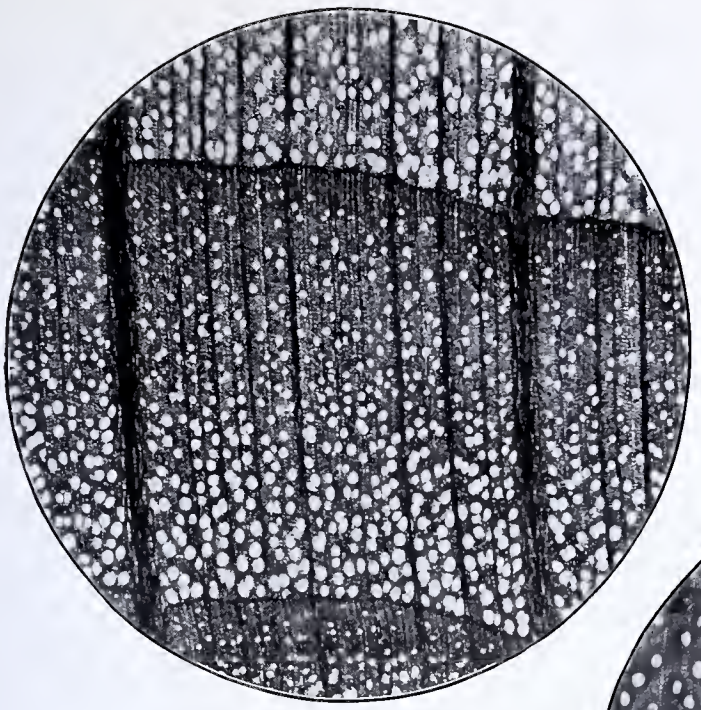
Hardness of wood refers to ability to withstand mechanical wear, indentation, etc. This table indicates approximately the hardness of important commercial species of wood. They have been so classified as to range between extremely soft to extremely hard.

Hardness terms used in the table are the same as those used in the key.

TABLE 27

HARDNESS CLASSIFICATION OF WOOD SPECIES

Hardness Description	*Hardwoods*	*Softwoods*
Extremely soft	Balsa	None
Very, very soft		None
Very soft		Cedar, northern white Cedar, southern white
Soft to Moderately soft	Basswood Buckeye Cottonwood	Spruce, Englemann Cedar, western red Pine, northern white Pine, sugar Pine, Pondosa Pine, Idaho
Moderately soft to Moderately hard	Poplar, yellow Butternut Chestnut Alder, red Gum, red Ash, black Elm, white (soft) Maple, silver Maple, red Sycamore Maple, Oregon Maple, black Gum, black	Pine, Norway Spruce, eastern red Spruce, Sitka Cypress, red Tamarack, eastern Cedar, incense Cedar, Alaska Hemlock, eastern Hemlock, West Coast Larch, western Pine, loblolly Fir, Douglas Cedar, Port Orford Pine, pitch Pine, shortleaf
Moderately hard to Hard	Cherry, black Elm, slippery (hard) Gum, tupelo	Pine, longleaf
Hard to Very, very hard	Birch, yellow Magnolia Ash, Oregon Beech Ash, green Oak, chestnut Ash, white Walnut, black Maple, sugar Oak, red Elm, cork (red) Oak, white Persimmon Mahogany (true)	None
Very, very hard to Extremely hard	Hickory, pecan Dogwood	None
Extremely hard	Cocobola	None



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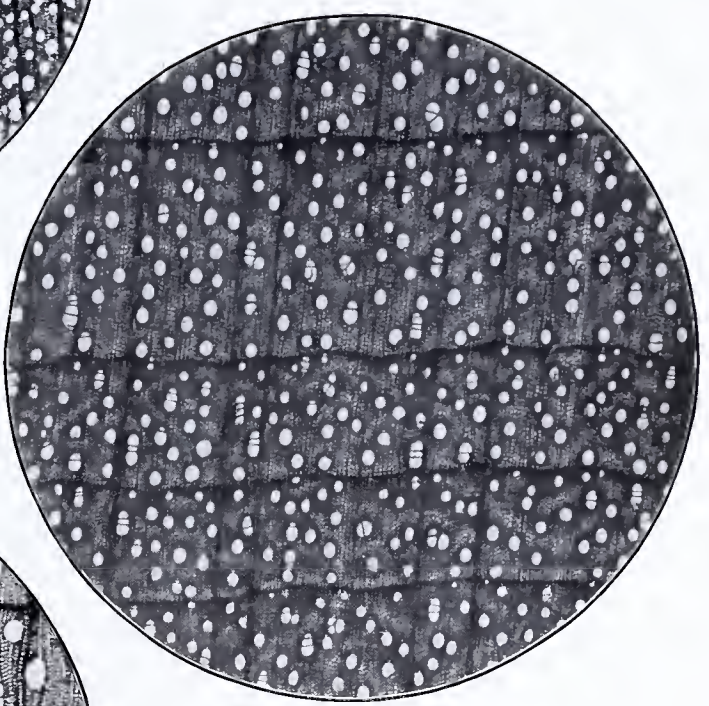

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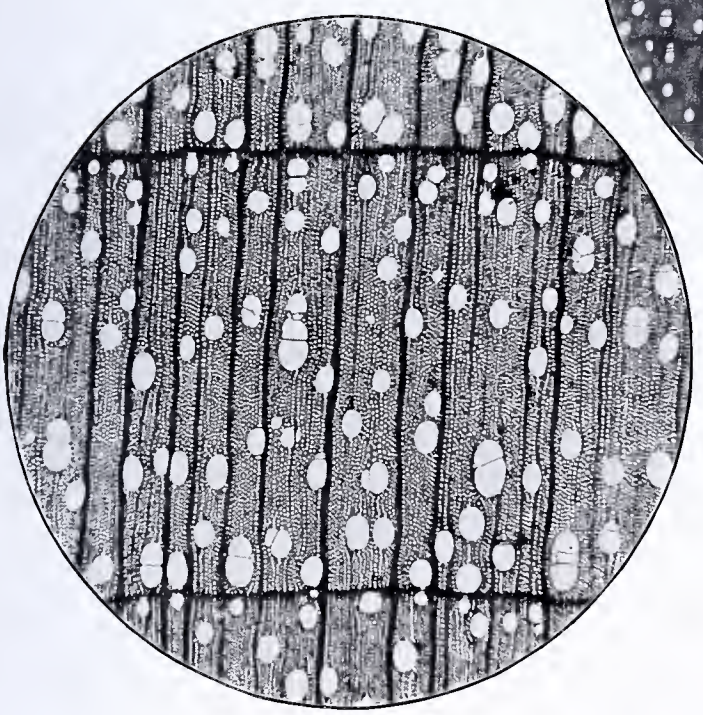

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Courtesy of Forest Products Laboratory

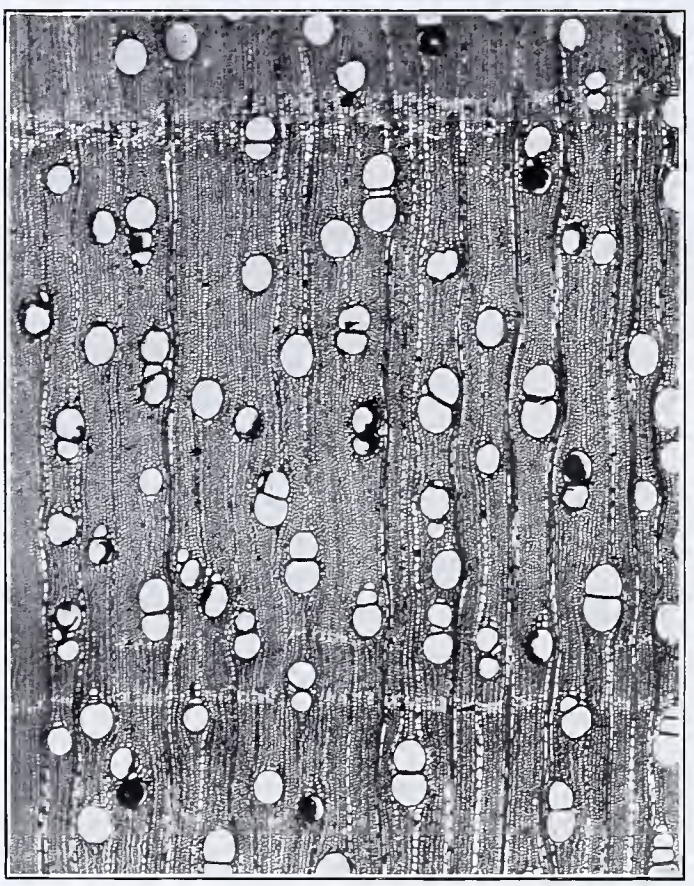
Plate XXXIV—How to identify beech, birch and maple.

Cross-sections of (A) beech, (B) hard maple, and (C) birch, all magnified 20 times.

Note in beech the wood rays, some very broad, separated by numerous smaller ones; also the crowded springwood pores decreasing in size towards outer limits of annual ring, hence giving rise to a harder and darker band of summerwood.

In the hard maple the wood rays are narrow, but quite distinct to the naked eye; pores are evenly distributed and often arranged in radial rows of two to three cells; note the wavy formation in the summerwood.

Birch shows rays which are fine and indistinct unless viewed under a lens, and much smaller than the pores, which are rather large and clear cut even without hand lens—usually larger than maple.



Courtesy of Forest Products Laboratory

Plate XXXV—Cross-section of true mahogany magnified 20 diameters, showing deposits of gum in the pores. This is typical of true mahoganies. The annual growth ring is rather indistinct.

How to Use the Key

Let it be assumed that a piece of wood is of questionable species, and it is desired to identify it by using the hand lens key.[1] It will be noted that definite suggestions have been given as to the method of preparing the sample piece for tracing down the species in the key.

The block has been prepared and shows clean, clearly cut, cross-section, radial, and tangential surfaces; a drop of water will bring out vividly the structure of the wood.

The first thing to definitely decide is whether it is a hardwood or a softwood species. Turn to the page which starts the key.

It will be seen that the key is split up into two distinct groupings:

Softwood key
Hardwood key

Following each notation is either a group of numbers (as 15A or B; 31A, B, or C, etc.) or the name of a species. In the case of numbers, they refer to another classification, which must be followed through the key until the species is at last identified. The identification is made step by step, referring to other classifications, by a process of elimination. These classifications are generally given in comparison to each other; positive, or negative, or graduation in size of the wood elements. For example:

1A: Wood shows evidence of resin canals..... 2A or 2B
1B: Wood in which resin canals are absent.....13A or 13B

or

31A: Rays comparatively broad and plainly evident to naked eye; the widest twice as wide as the largest pores, etc.....32A or 32B
31B: Rays narrow but quite distinct to the naked eye, the widest about the same width as the largest pores.....33A or 33B
31C: Rays fine, narrower than pores.....35A or 35B

Descriptive paragraphs in the key are indented to indicate still further separations or breakdown of main classifications. Large main segregations are shown on the extreme left, and are followed by indented classifications. Numbering is done progressively, starting with 1A and 1B, and ending with 43A and 43B. Thus, the final identification of the species is found in the indented classification at the extreme right.

On each page opposite the key is found additional descriptive information in regard to terms used in the key. Each discussion is given under a number referring to the classification grouping in the key. For example:

A: Pores and Vessels:

Note carefully Plate No. II, and discussion on porous and nonporous woods.

The terms "pores" and "vessels" are synonymous, but pores refer more specifically to vessels as seen in cross section.

Porous woods
Diffuse-porous
Nonporous wood—softwoods (conifers)

Note that the hardwoods are somewhat more heterogeneous and irregular in their make-up than the conifers.

[1] It is suggested that a hand lens of 15 to 20 magnification be used in conjunction with the key.

27A: The Elms

The following is a simple method of identifying the various elms: White elm: springwood pores are generally arranged in a single row and they are approximately the same size; wood moderately hard; light brown to gray. Rock elm: springwood pores usually in single row but varying considerably in size; wood hard to very hard; light brown to pinkish cast. Slippery elm: springwood pores usually occur in several rows; wood has odor similar to licorice; dark or chocolate-brown in color; wood hard and heavy. (See Plate No. XXXI.)

Many of these notations have not been made in the key, in order not to make it too complicated with lengthy discussions and to keep it as simple and clear-cut as possible.

Before actually proceeding with the key it will be helpful to note carefully the color, hardness, and weight of the sample in question and to keep these points in mind while working with the key. A known set of sample woods will aid in a final check-up after identification is made.

With definite knowledge of the arrangement of the key and the method of following it, the process of identifying an unknown wood would be similar to the example given below:

With the hand lens view carefully the cross-section surface of the sample, and find out if the wood contains pores or lacks pores. This first step will immediately indicate whether the hardwood or the softwood key is to be followed. Assume that the sample piece contains pores and is therefore a hardwood. Further reference is then made to the hardwood key, which refers to either classification 22A or 22B.

22A: Wood exhibits ring-porous condition, etc.....23A or 23B

22B: Wood exhibits diffuse-porous conditions, etc.....30A or 30B

It is now necessary to view again the cross-section surface, with the idea of finding out whether the wood is ring-porous or diffuse-porous. Assume that the sample contains "pores which are uniform in size and evenly distributed throughout the annual ring" (pores "at the beginning of the annual ring are not comparatively large, and form a distinct porous ring"). Therefore, the sample belongs to some one of the diffuse-porous woods, and further identification is made by following 30A or 30B. Hence it follows that the species will be identified some place in classification group 30A or 30B.

30A: states "Pores comparatively small, almost indistinct without hand lens, numerous and quite evenly distributed throughout the annual ring".....31A, 31B or 31C

30B: states, "Pores comparatively large, and evident to naked eye, often more numerous in springwood but lack definite formation to form annual ring.....43A or 43B

In the sample the pores are just visible under the hand lens and are widely scattered throughout the ring. Therefore, the classification comes under 31A, 31B, or 31C.

Separation from this point on depends to a large degree upon the size and types of wood rays. Read carefully 31A, 31B, and 31C. Note whether the rays in the sample block, the color, and other elements are similar to species described under the different group classifications; compare these to known samples. This will serve later as an additional check.

Assume that the rays in the sample in question are extremely fine and narrow.

31C: states, "Rays fine, narrower than pores".....35A or 35B

Group classification 31C is then followed. The sample therefore must be one of the species shown in this group.

35A: states, "Ripple marks present on tangential surface".....36A or 36B
35B: states, "Ripple marks absent on tangential surface".....37A or 37B

The descriptive notes on the opposite page briefly discuss ripple marks in wood, how they appear, and in which woods they are found. Very carefully examine the tangential surface of the sample for ripple marks. Only two species are shown; namely, mahogany and buckeye. Compare known samples of these woods to the sample in question. The color of the unknown sample is light grayish-brown and does not resemble either mahogany (deep reddish-brown) or buckeye (white). No ripple marks are evident on the sample. It therefore does not belong to either species, and 35B is then followed.

Identification has now been narrowed down to a species in 35B. Further breakdown is determined on visibility of the rays and pores.

Examination previously indicated that in cross-section the rays in the sample were very fine, and almost indistinct unless viewed through the hand lens, and for this reason group classification 37B should be followed, since

37B: states, "Rays very fine, and indistinct without use of hand lens"..39A or 39B

Identification is now limited to either 39A or 39B. Again compare known samples in this group to the unknown sample. Size of pores is the striking means of further identification, since

39A: states, "Pores appearing comparatively large, and clear-cut, conspicuous under lens".....40A or 40B
39B: states, "Pores appearing comparatively small, minute even under hand lens".....41A or 41B

Rays in the sample (as mentioned previously) are fine, and pores—even when viewed through the hand lens—are quite small, therefore 41B is followed. The unknown sample must be either red gum, red alder, or tupelo. Compare and recheck color, hardness, and weight of the known samples of these woods to the unknown sample.

41A: can be discarded immediately, since it states, "Heartwood dark brown with decided reddish cast, etc." (Color of unknown sample is light grayish-brown), and thus red gum is eliminated.

41B: states, "Heartwood light grayish-brown to light reddish-brown"..42A or 42B

This limits the identification to either 42A (red alder) or 42B (tupelo gum).

42A: "Heartwood light reddish-brown, etc." can be eliminated on account of color.
42B: states, "Heartwood light grayish-brown, high luster, pores variable in size and abundance, usually crowded and small, tyloses absent, gum ducts present".....Tupelo Gum

A final, very careful examination reveals that the unknown species precisely answers this description (42B) and is therefore tupelo gum. In order to recheck, compare the sample to a known sample of tupelo. If necessary, go again through the key. Read also general description of tupelo.

HAND LENS KEY METHOD FOR THE IDENTIFICATION OF SOME OF THE IMPORTANT COMMERCIAL SPECIES OF WOOD

The First Step

Definitely ascertain if the unknown species is a hardwood or a softwood. A careful examination of the cross-section surface will indicate which it is.

If the wood lacks *pores* (*vessels*), it is a softwood.
If the wood contains *pores* (*vessels*), it is a hardwood.

This determined, follow the key given for Softwoods or Hardwoods.

References to color, weight, and hardness, as given in Key, allude to those properties as shown in Tables 25, 26 and 27.

TERMS USED IN THE SOFTWOOD KEY

References in this key may be located readily by use of the Index in the back of the book.

A: Pores and Vessels:
Note carefully Plate No. II, and discussion on porous and nonporous woods.
The terms "pores" and "vessels" are synonymous, but pores refer more specifically to vessels as seen in cross-section.
Porous woods
Diffuse-porous
Nonporous wood — Softwoods (conifers)
Note that the hardwoods are somewhat more heterogeneous and irregular in their make-up than the conifers.

2A Resin canals or resin ducts:
Resin canals are only found in the softwoods. Under the lens they appear on the cross-section surface as fine white or darker spots normally scattered singly, rarely in groups, usually in the outer half of the springwood or in the summerwood of the annual ring. On the radial and tangential surfaces, where they are more easily seen, they appear as fine lines or dots of open structure or different color. They always run parallel to the grain. (See Plate No. V.)

3A and 4A Even grain, coarse grain, fine texture, etc.:
Read carefully the discussion on grain and texture. "Grain" refers to the cell elements and the arrangement of cells across the grain. "Texture" refers to the size of the cells and proportional volume of the various tissues.

3A and 3B Transition from springwood to summerwood abrupt or gradual:
Refer to Plate No. V. and discussion under springwood.
Each annual ring is made up of two distinguishable types of growth: the inner, known as springwood (early wood put on by the tree in the early spring) and summerwood the outer, known as summerwood (late wood put on by the tree in summer or autumn). It is the abrupt or gradual change in the size or the cell elements (vessels, etc.) which is reflected in the gross appearance of the wood. Abrupt change refers to a sudden change in the elements; gradual change refers to a gradual decrease in size or wall thickness of the elements.

SOFTWOOD KEY

(Note carefully the discussion on "How to Use the Key" in this chapter.)

1A Wood shows evidence of resin canals.....2A or 2B

2A *Resin canals* numerous, are generally conspicuous and readily visible to the naked eye on most cross-sections, forming rather thin dark hair-like lines.....3A or 3B

3A *Transition from springwood to summerwood gradual*, wood soft, *even-grained* (not disclosing pronounced summerwood), light in weight.....4A or 4B

4A Wood fine-textured, annual ring (seasonal zone) quite wide but often variable, resin ducts appearing clearly with the naked eye as white flecks on cross-section surface, heartwood pinkish-white, *silky luster*.....NORTHERN WHITE PINE

4B Wood relatively coarse-textured, *annual ring* (seasonal zone) usually narrow and of uniform width, resin ducts appearing to the naked eye as rounded openings in cross section.....5A orA5B

5A Resin ducts quite evident and rather large, appear as dark-colored lines on radial and tangential surfaces, heartwood creamy-white (never deeply-reddish), luster dull SUGAR PINE

4A, Luster:

Luster or gloss refers to the power of wood to reflect light. The opposite of high luster is dull luster.

Spruce has a pearly "dappled" luster
Cypress has a "greasy" luster
Eastern red cedar (on tangential surfaces) has a frosted luster
Redwood has a (silver grain) dull luster
Wood rays on radial surfaces have high luster.

4B Annual ring:

Refer to Plate Nos. II, IV and V, and discussion.

4A, 10A, 16A Spruce, hemlocks, pines:

Additional features for the identification of these woods are given in:

Forest Products Laboratory Technical notes, No. 215, entitled *The White Pines.*

6A California sugar pine — Pondosa pine:

Refer to chapter on Pondosa pine.

6B Southern yellow pine:

Identification of the various southern yellow pines is difficult. For detailed discussion other than shown, attention is called to

Forest Products Laboratory Technical Note No. 141, "*Visual Method of Distinguishing Longleaf from Shortleaf and Loblolly Pine.*"

2B Resin canals limited or scattered, etc.:

Resin canals are found predominately in the four following woods: the pines, the larches, Douglas fir, and the spruces. In the pines they are most abundant and in the larches, Douglas fir, and the spruces less abundant, much smaller, and often grouped.

5B Resin canals usually not so evident, heartwood deep purplish-white... IDAHO WHITE PINE

3B Transition from springwood to summerwood abrupt, wood moderately soft to moderately hard, rather *coarse-grained* except certain types of Pondosa pine (California white pine).....6A or 6B

6A Summerwood generally narrow, heartwood creamy-white.....PONDOSA PINE (California sugar pine is generally finer-textured, softer, and lighter than Pondosa pine)

6B Summerwood bands usually broad, wood varies from moderately heavy to heavy and moderately soft to moderately hard, quite resinous, heartwood varies from brown to reddish brown in color.....SOUTHERN YELLOW PINES (7A or 7B)

7A Wood somewhat resinous moderately light, and moderately soft, width of annual ring variable, summerwood not always sharply defined, heartwood yellowish-white to reddish-brown..SHORTLEAF PINES (8A or 8B)

8A Wood pale yellow to yellowish-white, wood moderately soft, ring growth usually narrow, somewhat resembles the "white" pines in texture and grain.....ARKANSAS SOFT PINE

8B Wood reddish brown, moderately soft, ring growth extremely variable — generally broad..NORTH CAROLINA or LOBLOLLY PINE

7B Wood extremely resinous, moderately heavy and hard, ring growth generally narrow, decided summerwood formation in which are heavy resinous desposit..LONGLEAF PINE

2B Resin canals limited or scattered, small and scarcely visible, or apparently lacking unless viewed with the hand lens.....9A or 9B

9A Summerwood formation not pronounced, transition from springwood to summerwood gradual, texture fine, decided satiny luster, lacking clear demarcation between heartwood and sapwood.....10A or 10B

10A Wood white, with practically no contrast between heartwood and sapwood, texture very fine, resin ducts very indistinct and not apparent without Hand lens.....EASTERN SPRUCES

10B Wood light silver-gray with decided pink tinge.....SITKA SPRUCE or ENGELMANN SPRUCE

9B Summerwood formation clearly defined, transition from springwood to summerwood generally abrupt, no evidence of luster, texture often coarse and woolly....11A or 11B

11A Resin canals small and widely scattered rarely paired, appearing in the late summerwood as white dots, usually resinous, wood heavy and hard... 12A or 12B

12A Wood decidedly pitchy and resinous, coarse and hard, color red to reddish-brown..Western Larch

12B Wood usually not so resinous, texture medium, often coarse-grained color light yellowish-brown—not reddish.....Eastern Tamarack

11B Resin canals quite apparent, variable in size, usually appearing grouped in short tangential rows, wood has characteristic odor but not excessively resinous, heartwood orange to deep red, wide range in texture of the wood.....
Douglas Fir

11B Douglas fir:
The color and texture of Douglas Fir varies considerably. For details of these variations attention is called to the chapter on this wood. Also Forest Products Laboratory Technical note No. 198:
The Identification of Douglas Fir Wood.

1B Wood in which resin canals are absent..13A or 13B

13A *Wood not giving off aromatic odor*...14A or 14B

14A Wood having a waxy or greasy feel as though impregnated with waxes or paraffin, odor rancid when wet or green, sharply defined summerwood much darker than the springwood, color variable from yellowish to reddish-brown (sometimes almost black)
Southern Cypress

13A Odor or scent of wood is common in green wood. Upon seasoning odor lessens in its intensity and in some species is not noticeable at all when the wood is thoroughly dry. Odor depends upon oils, organic matter, etc., found in the wood elements. The pines have a resinous or turpentine odor; southern white cedar an aromatic odor similar to cedar oil. Alaska cedar, Port Orford cedar, incense cedar, all have a spicy, resinous odor. Cypress has a rancid odor, and so on.

14B Wood not having a waxy or greasy feel
15A or 15B

15A Heartwood deep reddish-brown (sometimes may be light red), wood even-grained but coarse-textured.Redwood

15B Heartwood ranges from light yellowish-brown to light brown.....16A or 16B

16A Heartwood light brown, wood often harsh and slivery, annual ring variable in width.....
Eastern Hemlock

16B Heartwood pale brownish-yellow with decided red tinge, annual rings fairly uniform in width, *traumatic resin* canals frequently present in rows, green wood gives off a peculiar sour odor, wood of uniform texture, usually lacking extremes in hardness, splintering, etc., transition from springwood to summerwood gradual.....
West Coast Hemlock

16B Traumatic resin canals:
Resin ducts may be produced by injury to the tree, in species where they do not naturally occur, especially the hemlocks, true firs, and redwood. They are distinguished from the true resin canals by their peculiar location; viewed in cross section they form one or more rows concentric with the growth ring. (See Plate No. XXVII.)

13B Wood having a decided aromatic odor.....
17A or 17B

17A Heartwood light creamy-yellow to clear yellow with little evidence of clear demarcation between heartwood and sapwood; wood has spicy taste and aromatic pungent odor.....18A or 18B

18A Heartwood with decided clear yellow color, pronounced pungent odor, spicy resinous taste.....Alaska Cedar

18B Heartwood creamy yellow, odor extremely pungent, texture fine....
Port Orford Cedar

13B The identification of the cedars is based largely upon odor, taste, and color. These features do not hold rigidly in every instance.

17B Heartwood light brown to deepish-brown, never yellow, summerwood distinct and conspicuous.....19A or 19B

19A Heartwood light brown or light brown with pink cast, *little contrast between heartwood and sapwood*, wood spongy soft.....20A or 20B

20A Heartwood light brown with pink cast, odor quite pronounced, ring growth generally wide.....
Southern White Cedar

19A Little contrast between heartwood and sapwood:
Refer to discussion on heartwood and sapwood. In most species there is a decided contrast in the color of the heartwood and the sapwood.

20B Refer to Plate No. XXVIII.

21A Peckyness:
Peckyness is common in incense cedar and cypress. Refer to discussion on peckyness.

21B Contrast to seasonal zones:
Refers to striking demarcation of growth ring caused by the abrupt change in density and color between the summerwood and the springwood of the next year's growth. In some species it is much more striking than in others, and can be used for identification purposes.

TERMS USED IN HARDWOOD KEY

References in this key may be located readily by use of the Index in the back of the book.

22A or 22B Ring-porous and diffuse-porous woods:
See Plate No. IV. Also discussion of ring-porous and diffuse-porous woods.

23A Summerwood with wavy or branched radial lines, etc.:
These lines are generally noticed as lighter colored wood masses and spread out parallel to the wood rays. Note in Plate No. XXIX the appearance of these bands.

24A Wood rays:
Wood rays are frequently called pith rays, medullary rays, etc., and appear in cross-section as fine lines, extending from the pith to the bark. In radial surfaces they appear in varying size, depending upon the species, as "flakes" of generally darker-colored wood. They occur in both hardwoods and softwoods. In oak and sycamore they are large and quite pronounced in tangential surface, the ends of the rays are visible and show their height and width. Refer to discussion on Wood Rays, and Plates Nos. I, III, and XXXIII, for additional details.

25A Springwood pores (in ring-porous woods):
"Pores occurring in springwood," etc. Such pores are generally larger and thinner walled. Summerwood pores are not as numerous as springwood pores, and because they are smaller in size and less conspicuous there develops a definite contrast, which gives rise to definite zoning or rings. In the diffuse-porous woods there is usually no marked contrast or differentiation between the size of the vessels in the springwood or summerwood and the pores are more or less diffused over the entire area. The demarcation of the annual ring in these woods is generally caused by several factors:

Gradual decrease in size of vessels
Reduction in the number of vessels in summerwood
Change in the type of wood elements
Increase in thickness of the walls of tracheids or flattening of the wood elements near the limit of the summerwood

In the softwoods where vessels or pores are not

20B Heartwood light brown, wood often soft and *brash*, ring growth generally narrow.....
NORTHERN WHITE CEDAR

19B Heartwood decidedly red to deep reddish-brown.....21A, 21B or 21C

21A Heartwood pale reddish-brown, spicy taste, heartwood often *pecky*.....INCENSE CEDAR

21B Heartwood reddish-brown to dark brown, wood light in weight, soft, texture firm, decided *contrast to seasonal zones*, wood never pecky
WESTERN RED CEDAR

21C Heartwood deep clear red, often streaked with purple, odor and taste mild, not sweetish or spicy, never pecky. EASTERN RED CEDAR

HARDWOOD KEY

Note carefully the discussion on "How to Use the Key," in this chapter.

Wood clearly shows evidence of pores (vessels).22A or 22B
(Pores vary in size but are conspicuously larger than the surrounding cells; resin ducts are absent; wood rays varying from minute to large and conspicuous, wood parenchyma present in variable amounts).

22A Wood exhibiting *ring-porous* condition; the pores at the beginning of the annual ring are comparatively large and form a distinct porous ring; pores decrease in size more or less abruptly towards the summerwood..... .....23A or 23B

23A *Summerwood with wavy or branched radial bands*, which are visible without the hand lens on smoothly cut cross-sectional surface..24A or 22B

24A *Wood rays* inconspicuous and very fine, wood moderately soft and moderately light, heartwood dark yellowish-brown.....
CHESTNUT

24B Wood rays very broad and conspicuous on radial surface, wood heavy to very heavy, and hard, odor in wet or green wood.....
25A or 25B

25A *Springwood* pores in heartwood usually open showing few if any *tyloses*, pores in summerwood so small and numerous as to be exceedingly difficult to count, heartwood brown without reddish tinge.....WHITE OAK

present, the ring is caused by variations in the tracheids (size, thickness of walls, etc.).

25A or 25B White oaks and red oaks:

Detailed methods of identifying red and white oaks are discussed in Forest Products Laboratory, Technical Note No. 125 — *Identification of Oak Woods*. Refer also to discussion given under Description of the Wood, in the chapters on these woods.

25A Tyloses:

Refer to Plate No. XXIX. Tyloses are pith-like strictures forming cells which appear within the vessels of hardwoods and the resin canals of softwoods. They are plainly visible in some woods, appearing as "froth," and tend to block up the vessels, or cells, and render them impervious to the passage of liquids. They are formed in the wood at the time that the various elements become a part of the heartwood. They are typical and quite common in practically all of the white oaks, black walnut, slippery elm, locust, hickories, etc. In the softwoods they are found in the pines, and to a lesser extent in spruce, and only sparingly or not at all in larch and Douglas fir. Apparently, the abundance of tyloses tends to increase durability.

27A Wood parenchyma:

Refer to Plate No. XXX. Parenchyma is an important element of wood structure and occurs:

Vertically, in the form of scattered rows of cells (wood parenchyma), visible in cross section as small cells

Horizontally, as plates of cells in the wood rays (ray parenchyma)

True wood parenchyma cells are subject to wide variations in distribution and arrangement. In cross section the parenchyma cells appear:

Scattered irregularly throughout the growth ring

Arranged in tangential lines or bands

Terminally, forming outer limits of the growth ring

Surrounds pores

Arranged in radial rows

In the softwoods, wood parenchyma occurs quite as found in the hardwoods (terminally, scattered, or zoned). In the hardwoods, the occurrence of parenchyma is an important means of identification.

27A The elms:

The following is a simple method of identifying the various elms:

White elm: springwood pores are generally arranged in a single row and they are approximately the same size; wood moderately hard; light brown to gray.

Rock elm: springwood pores usually in single row but varying considerably in size; wood hard to very hard; light brown to pinkish cast.

Slippery elm: springwood pores usually occur in several rows; wood has odor similar to licorice; dark or chocolate-brown in color; wood hard and heavy. (See Plate No. XXXI.)

28A The ashes:

Black ash is considerably lighter, softer, and weaker than any of the commercial white ashes — namely, the true white, green, blue, and Biltmore species. For this reason it is desirable in many cases to have a means of distinguishing black ash from white ash lumber. The following summary has been prepared by the Forest Products Laboratory, Madison, Wis., for this purpose. Some of the differences between the two woods are to be noted by ordinary inspection. Finer structural differ-

25B Springwood pores in heartwood generally filled with tyloses, pores in summerwood quite large and evident without the hand lens, so few as readily to be counted, heartwood reddish-brown particularly near knots, wood rays on tangential surface usually short, not over one inch long (in white oak rays are long; frequently five inches in length, narrow and straight).....Red Oak

23B Summerwood figured, not with radial bands, but with distinct bands or patches arranged tangentially, clearly visible with use of hand lens...26A or 26B

26A Pores in summerwood very numerous..27A

27A Careful examination with hand lens shows pores of the summerwood very small and numerous and arranged in a striking pattern producing a zigzag or wavy appearance, *wood parenchyma* not visible with lens, heartwood light brown or gray to chocolate-brown, rays not distinct without a hand lens..
The Elms

26B Pores in summerwood few, solitary or subdivided radially into groups of two to four pores.....28A or 28B

28A Parenchyma surrounds pores and appears in long, wavy, tangential lines, sometimes winglike in fashion, pores in summerwood much smaller than those in springwood, heartwood silvery-brown to grayish or greenish brown, wood heavy and hard.....The Ashes

28B Parenchyma does not surround pores but appears as fine concentric lines; frequently pores in summerwood are as large as pores in springwood but not

ences may be seen with the aid of a hand lens magnifying about fifteen diameters. As an additional aid to identification, a diagrammatic drawing showing the structure of black ash and white ash may be obtained from the Forest Products Laboratory upon request. The ashes all belong to the group of "ring-porous" hardwoods — that is, woods having one or more rows of large pores or cells formed at the beginning of each year's growth or annual ring. The pores are much larger than the other cells or fibers which make up the annual ring, and their arrangement causes the appearance of conspicuous concentric rings on the end grain of the log. The portion of each annual ring which contains the large pores is the springwood, and the denser, darker-colored portion the summerwood. The following tabulated summary (as referred to above) of the difference between black ash and white ash may be found convenient for reference:

SUMMARY OF THE CHARACTERISTICS WHICH MAY BE USED TO DISTINGUISH BLACK ASH FROM THE COMMERCIAL WHITE ASHES

	Black Ash	*Commercial White Ashes*
Average weight per cu. ft. 15% moisture	35 lbs.	40 lbs.
Width of sapwood	Usually less than 1 in.	Several inches wide
Color of heartwood	Plain brown, tinged with olive	Grayish - to reddish - brown, often pale
Shape of larger springwood pores or vessels on cross-section	Usually oval	Usually round
Tyloses in inner sapwood and heartwood	Usually absent, scattering if present, very rarely numerous; pores usually may be blown through without difficulty	Always present, usually abundant. Usually difficult or impossible to blow through pores
Fine white lines (parenchyma projections) in the summerwood	Very rare, fine, and usually short if present	Variable, but generally present; frequently long and very prominent

29B Ripple marks:

Certain woods, on carefully cut tangential surface, show fine, delicate cross lines of stripes, referred to as "ripple marks." Three species in which they occur and are visible to the naked eye are: persimmon, buckeye (yellow), true mahogany (may sometimes show marking on one piece and not on another); basswood sometimes shows under lens on tangential surface indistinct "ripple marks."

22B Diffuse-porous woods:

Refer to discussion given under 22A.

31A (See Plate No. XXXIII.)

so numerous.....29A or 29B

29A No evidence of ripple marks on tangential surface, wood parenchyma distinct without use of lens, pores often filled with tyloses.....THE HICKORIES

29B Ripple marks plainly evident on tangential surface, pores open, wood dark brown, often streaked, PERSIMMON

22B Wood exhibiting *diffuse-porous* condition; pores are of uniform size and evenly distributed throughout the annual ring or if they are slightly larger and more numerous in the springwood, they gradually decrease in size and numbers towards the outer edge of the annual ring, but do not form a distinct band or ring.....30A or 30B

30A Pores comparatively small, almost indistinct without the use of hand lens, numerous and quite evenly distributed throughout the annual ring.....31A or 31B or 31C

31A Rays comparatively broad and plainly evident to the naked eye, the widest fully twice as wide as the largest pore, appearing on radial surface as distinct "flakes" — similar to those in the oaks only smaller, heartwood in various shades of reddish-brown..32A or 32B

32A Nearly all rays broad, pores crowded, decreasing little if any in size at the extreme outer edge of the annual ring, wood moderately light and moderately soft, heartwood brown tinged with red, radial surface shows striking wood ray ("flakes").....SYCAMORE

32B Only part of rays broad, separated by numerous narrow ones:
This type of ray is sometimes spoken of as a compound ray. A close examination under the lens of a cross-section of beech in which this condition is typical will disclose such types of rays.

31B (See Plate No. XXXIII.)

32B, 34A, 40A For additional identifying features of beech, birch, maple, cherry, etc., attention is called to Forest Products Laboratory, Technical Note No. 116. *How to Tell Birch, Beech, and Maple Apart.*
(See Plate No. XXXIV.)

34B Pores often larger in springwood, becoming smaller in summerwood:
Frequently walnut and cherry tend to show a greater number of large vessels in the springwood than in the summerwood, and approach a ring-porous condition.

34B Pith flecks:
Pith flecks (pith flakes) are small dark-brown or grayish half-moon-shaped patches clearly apparent in cross-section surfaces of many diffuse-porous woods. On tangential surfaces they appear as fine, dark lines. They are quite common in cherry, soft maple, basswood, etc.

31C (See Plate No. XXXIII.)

35A "Ripple marks":
Refer to discussion shown under 29B. (See Plate No. XXXII.)

36A True mahogany:
For additional information on mahogany, refer to chapters on True Mahogany and So-called Mahoganies. Also, the bibliographies shown under "Bibliographies" for this species and Forest Products Laboratory, Technical Note No. 162, entitled *Distinguishing Characteristics of Mahogany* and No. 103 entitled *How to Distinguish Mahogany and Walnut from Red Gum.*
(See Plate No. XXXV.)

38A Yellow poplar and magnolia:
Magnolia is quite similar to the sapwood of yellow poplar. Under the lens the pores of poplar are rarely shown as occurring in radial groups. In magnolia the pores usually occur in radial groups of from 3 to 8.

32B *Only part of rays broad,* separated by numerous narrow ones, the others narrower than the largest pores, pores in springwood crowded, decreasing in size and numbers towards outer edge of annual ring, thus effecting a harder and darker band of summerwood, wood moderately heavy and hard.... BEECH

31B Rays narrow and quite distinct to the naked eye, the widest ones about the same width as the largest pores.....33A or 33B

33A Wood parenchyma only faintly visible under hand lens, parenchyma arranged in somewhat broken tangential lines, wood very heavy and very, very hard, DOGWOOD

33B Wood parenchyma not arranged in tangential lines.....34A or 34B

34A Heartwood light reddish-brown, distinct ray flakes visible on radial surface, darker than background, pores fairly evenly distributed and not scattered..THE MAPLES

34B Heartwood reddish-brown, rays on radial surface lighter than background, *pores often larger in springwood,* gradually becoming smaller in summerwood, pores quite numerous, solitary, or grouped, dark gum often noticeable in vessels, gum streaks or *pith flecks*.....BLACK CHERRY

31C Rays fine, narrower than pores.35A or 35B

35A *Ripple marks* present on tangential surface.....36A or 36B

36A Heartwood deep reddish-brown, wood hard and heavy, rays fine but distinct, pores rather large, clear demarcation of annual ring often lacking, dark gum or white deposits often fill pores..... TRUE MAHOGANY

36B Heartwood white, wood light and soft, often lustrous, pores very small and minute, rays distinct under lens.....BUCKEYE

35B Ripple marks absent on tangential surface.....37A or 37B

37A Rays fine but distinct to naked eye.....38A or 38B

38A Heartwood yellowish-brown with a greenish tinge, wood moderately light, annual ring appears on smooth, clear-cut cross sections as terminating in a white band, wood odorless.....YELLOW POPLAR

38B Heartwood creamy-white, rays on radial surface visible without lens, wood light and soft, characteristic odor when wet or green.....BASSWOOD

37B Rays very fine and indistinct without use of hand lens..... 39A or 39B

39A Pores appearing comparatively large and clear-cut, conspicuous under lens..... 40A or 40B

40A Pores not crowded, decreasing little if any in size towards the outer limit of the annual ring, rays indistinct even under hand lens, heartwood light reddish-brown, wood heavy and hard.....THE BIRCHES

40B Pores crowded, decreasing in size and numbers towards the outer limit of annual ring, often rays are invisible even under hand lens, heartwood light grayish-brown, texture coarse, wood light and soft.... COTTONWOOD

39B Pores appearing comparatively small, minute even under hand lens.41A or 41B

41A Heartwood dark brown, with decided reddish cast, sapwood light pink, very susceptible to blue sap stain, rays fine but quite visible under hand lens, close together, one-half of the wood area is composed of rays, pores crowded, wood moderately light, tyloses abundant....RED GUM

41B Heartwood light grayish-brown to light reddish-brown..42A or 42B

42A Heartwood light reddish-brown, luster dull, pith flecks common, pores barely visible to naked eye, somewhat more numerous in springwood, RED ALDER

42B Heartwood light grayish-brown high luster, pores variable in size and abundance, usually crowded and small, tyloses absent, gum ducts present..... TUPELO GUM

42B Tupelo gum:

Black gum and tupelo gum are quite similar, and identification is extremely difficult. Actual comparison to a known species is the best method of identifying them. A knowledge of the regional habitat will also aid greatly.

30B Pores comparatively large and evident with the naked eye, often more numerous in springwood but lack definite formation to form annual ring.....43A or 43B

43A Heartwood deep chocolate-brown in color, wood moderately heavy and hard.....BLACK WALNUT

43B Heartwood light chocolate-brown in color, wood light and moderately soft, BUTTERNUT

WOODS AT A GLANCE

This section provides concise and precise information concerning the properties and limitations of woods which are commercially important. For more extended information read the chapters in this book which discuss the species in which you are interested.

Still further information can be obtained by following the references which occur in each chapter and the references in the general Bibliography.

Hardwoods

Species of Wood	Outstanding Properties	Limitations
Alder (red)	Most important hardwood of Pacific northwest; fabricates well; strong for its weight; finishes well	Regionally segregated; lacks distinct figure; supply limited; relatively soft
Ash (white)	Best of the ashes; strong, tough and resilient; "northern white" ash is considered toughest of the ashes	Lacks toughness of hickory; not exceptionally durable; southern ash frequently brash and soft—"Punk" ash
(black)	Similar to white ash, though not quite as strong; wood somewhat softer	Wood softer than white ash; color of heartwood is brown; not durable; limited in range
(Oregon)	Native of northwest; intermediate in its properties between white and black ash	Limited range; often brittle; heartwood brown
(green)	Quite similar to white ash in properties	
Basswood	Wood soft, light and easily worked; glues well; creamy white in color; seasons easily; holds shape well; has even grain	Lacks strength; easily marred or worn under mechanical wear; lacks figure; not durable
Beech	Hard; fairly strong and heavy; works fairly well; wears well	Checks frequently in seasoning; hard to handle in seasoning; nails poorly
Birch (yellow)	Wood is heavy; strong; rather hard; seasons well; fabricates well; heartwood has red tinge; finishes and stains well	Slight figure, except in occasional trees
	(Other birches—sweet, river, paper, white, etc.,—are quite similar in properties, but are restricted in distribution and size, and are not considered as superior as yellow birch. White birch is a favorite for turning)	
Buckeye (yellow)	Wood is soft, easily worked; tasteless; odorless; light in weight	Wood easily stained; limited in range and quantity; slight strength and wearing qualities; slight figure.
Butternut	Moderately heavy; hard; closely resembles black walnut; works easily; fabricates well; stains well	Lacks color; grain and general properties of black walnut; light in weight and weak (sometimes brash)
Cherry (black)	Wood is moderately hard and wears well; finishes well; holds shape well; attractive reddish color and luster	Species is limited in range and not abundant; subject to pith flecks

Species of Wood	Outstanding Properties	Limitations
Chestnut	Wood easily worked; easily seasoned and finished; excellent grades and quantities of chestnut are still available regardless of extent of "blight"; rather light; heartwood durable	Splits easily; frequently wormy
Cottonwood	Heartwood is brown; soft, and easily worked; wears fairly well for softwood; nails easily	Tendency to warp and twist; not resistant to decay; wood is weak
Dogwood	Very hard and heavy; wears excellently; capable of taking high, smooth polish	Limited in range; specialty wood; hard under tools
Elm (rock)	Wood is hard, heavy and very resilient; strongest of the elms; heartwood reddish brown	Somewhat difficult to dry; tendency to warp and twist; not specially durable
(white)	Wood is resilient; strong; moderately heavy but somewhat less so than rock elm. Considered the best of the elms; more easily worked than rock elm	Somewhat difficult to dry; tendency to warp and twist; not specially durable
	(The other elms—slippery, cork, wing, cedar—do not possess the superior qualities of either white or rock elm. Considerable variation is found in mechanical and physical properties of the "elms")	
Gum (black and tupelo)	Wood is fairly strong and resilient; tough, and hard to split. Tupelo is generally considered superior to black gum	Wood is heavier, harder than red gum; lacks figure, color; tendency to warp and twist in seasoning; blue stains easily
(red)	Wood is much favored by fabricators; rather soft; easily worked; well adapted to staining and finishing; attractive grain and figure; takes glue well	Not specially durable; tendency to warp and twist; sapwood blue stains easily
Hickory	Is one of our strongest, hardest woods; remarkable toughness and ability to withstand shock; heartwood reddish cast	Hard to fabricate under tools; not particularly durable
	(The many varieties of hickory are, in general, similar in physical and mechanical properties. Shagbark, shellbark, pignut and mockernut are the most favored)	
Magnolia (evergreen)	Wood moderately soft, light and strong; works well; easily seasoned; has satiny finish; takes glue well	Restricted range and growth;wood sometimes tends to warp and twist; color of heartwood often varies
Mahoganies—So-called African Mahogany Cedralas (a hardwood) Gaboon Colombian Mahogany Crabwood Sapeli Philippine Hardwoods tanguile lauaan (red) almon Indian Mahogany	Tropical hardwoods, and varying greatly in physical and mechanical properties; some are well adapted for industrial uses, veneer inlays, overlays, etc., where grain, color, and figure is required	Are not considered equal in beauty and value to true mahogany

Species of Wood	Outstanding Properties	Limitations
Mahoganies—True	Wood is moderately strong; tough and uniform in structure; grain is interlocked; holds shape well; works well; takes exceptionally fine finish and polish; attractive figure and color; heartwood varies from red to dark brown	Wide range in properties of the mahoganies; a specialty wood
Maple (hard) (sugar, black)	Wood is exceptionally strong, hard, with excellent wearing properties; large percentage of white sap wood; holds shape well; frequently carries attractive figure	Tendency to small hair-like checks if improperly seasoned; also mineral stains
(soft) (red, silver)	Red maple in its properties is midway between rock and soft (silver) maple; red maple has reddish tinge; soft maple is weakest of the maples; fabricates fairly well	Not especially durable; susceptible to pith flecks; red maple has reddish tinge; soft maple often susceptible to worms and insects; rather brittle
Oak (red)	All "red" oaks are quite similar in their respective properties; they are heavy, hard and strong; with exceptional toughness; attractive figure; season easily; finish well; take stains	Not as durable as white oak; somewhat lighter and not as strong; sometimes subject to checking; the "water" oaks often are difficult to season
(white)	White oak is the "standard" of our hardwoods; moderately heavy but very resilient and tough; fairly easy to work; takes stain and finish excellently; lighter in color than the red oaks	In some individual trees there appears tendency towards brashness
Pecan	Quite similar to the hickories in general appearance	Not durable; restricted in growth and range; lacking in strength
Persimmon	Wood is very heavy, hard, and has remarkable wearing ability; takes high polish	Somewhat difficult to work under knives; often takes on brown staining
Poplar (yellow)	A most popular wood; easily worked; holds its shape well; easily seasoned; finishes and takes stain excellently; durable; heartwood greenish yellow to brown. Lacks odor and color	Somewhat lacking in strength properties; somewhat brittle; lacks definite figure
Sycamore	Wood is moderately heavy; hard and stiff; attractive figure and color; somewhat resembles beech; fairly easily worked; seldom stains; does not impart odor or taste	Difficult to split; inclined to warp and twist; not durable
Walnut (black)	One of our most popular woods; exceptionally attractive color, grain and figure; wood is moderately heavy, hard and strong; fabricates well; takes excellent polish and finish	Specialty wood

Softwoods

Species of Wood	Outstanding Properties	Limitations
Cedars (eastern red)	Specialty wood; very durable; attractive color, figure, and markings; wood is light, soft, and easily worked; pleasing odor	Limited range and growth; often knotty which adds to attractiveness of wood; available in comparatively narrow and short lengths
(incense)	Wood rather light in weight; soft; easily worked; highly durable; heartwood light brown	Splits readily; poor shock-resisting ability; wood is aromatic; sometimes subject to "peckyness"
(northern white)	Soft, light and durable; heartwood is pale brown in color; easily worked	Its limited size controls its extensive use for lumber; limited range and distribution; little grain or outstanding figure
(Port Orford)	Light and soft; easily worked; available in wide assortment of sizes and lengths; very durable; very strong for a softwood; resists acids well; wood almost white in color	Pungent odor; limited in range to Pacific northwest
(southern white)	Very similar to northern white in general properties; heartwood is pinkish in color; available in lumber forms; durable	Range is limited; odor slightly greater than northern white
(western red)	Wood is exceptionally light; soft and close grained; considered an excellent cedar; warps and shrinks little; durable; easily worked; available in wide range of sizes and lengths; excellent for exterior construction purposes	Characteristic odor; sometimes brittle
(yellow or Alaska)	Wood is even textured; soft and easily worked; grain usually straight; durable; heartwood is clear yellow; shrinks little	Limited distribution and range in Pacific; not particularly strong; pungent odor
Cypress	Fabricates well; wood is moderately soft; rather light in weight; resembles redwood; very durable; well adapted for construction purposes; resistant to acids; attractive grain and figure; finishes well; excellent for exterior use	Often wood is affected by peck; red cypress considered superior to white or "yellow" cypress
Fir (Douglas)	Considered as one of our most popular softwoods; excellent construction wood; is moderately heavy; strong; fairly hard; stiff; available in wide range of sizes and lengths; easily worked; attractive flat grain; fairly durable	Some range in color of wood; occasionally brittle; resinous
Hemlock (eastern)	Wood is fairly close grained and even textured; works easily; holds nails well; light brown in color; no odor or taste when dry; somewhat hard; nonresinous; good general construction softwood	Wood is sometimes brittle; tendency to splinter; often defective (shakes, small knots, etc.)

Species of Wood	Outstanding Properties	Limitations
Hemlock (West Coast)	Wood is rather soft; easily worked; grain somewhat more uniform than eastern hemlock; lacks odor and taste when dry; available in wide range of sizes and lengths; considered good construction softwood; nonresinous	Not particularly shock-resistant; sometimes brittle
Larch (western)	Wood is moderately hard, heavy and strong; quite durable; smooth wearing; red in color; considered somewhat superior to eastern tamarack; finishes well, satiny	Resinous; tendency to check in seasoning; some shake
Pines (Idaho white)	One of true white pines; wood is easily worked; soft; shrinks but little; one of the lightest of pines in weight; quite strong for weight; heartwood white to brownish white	Limited range; soft; lacks wearing qualities; resinous
(northern white)	Considered the best of the pines; easily worked; very soft; straight grained; holds shape well, quite durable; fairly strong for weight (Norway Pine is quite similar to northern white pine)	Limited range; soft; resinous
(Pondosa)	Moderately light and soft; fairly strong; easily worked; holds nails well and shrinks and swells but little (California whitepine, although cut from the same species as Pondosa pine, closely resembles the true white pines)	Wide range in properties; resinous; sometimes brash and brittle
(southern yellow)	Considered as one of our most important general construction soft woods	Wide range in properties; all resinous
	Longleaf pine One of the heaviest, hardest, and strongest of the softwoods; is durable, tough and wears well; heartwood reddish yellow	Resinous and pitchy
	Shortleaf pine Rather soft textured; heartwood fairly durable; works easily; generally fairly free from hard pitch and streaks; heartwood pale yellow *Arkansas soft pine* has softest texture of the yellow pines; easily worked; and not excessively resinous	Wide range in properties; resinous
	Loblolly pine Wood fairly hard, tough and strong; heartwood range to yellowish brown	Extreme range in properties of wood; fast growth results in lack of strength; often brittle; resinous
(sugar)	Another true white pine; wood is light; soft; easily worked; shrinks and swells but little; holds its shape; available in wide range of sizes and lengths; heartwood pinkish brown	Resinous; soft

Species of Wood	Outstanding Properties	Limitations
Redwood	Wood is frequently coarse grained, but even textured; considered as one of our most important softwoods; very durable; works well and easily; moderately light in weight; shrinks but little; nonresinous; no odor or taste; heartwood red in color; well adapted for exterior use	Some variation in relative properties; occasionally brittle, flinty or hard
Spruce (eastern) red, white, black	Red, white, and black spruces are similar in general properties; light, soft and easily worked; strong for their weight; red spruce perhaps considered best of eastern group; heartwood pale white tinged with pink	Limited in general size of stock as compared to western spruces; limited in range
(Engelmann)	Wood is soft; easily worked; is heaviest of the spruces, and is lighter in weight than white pine; wood pale yellow tinged with red	Limited in range to Rocky Mountain region; wood is not exceptionally strong for its weight
(Sitka)	Wood is light, soft and very easily worked; available in large sizes and lengths; shrinks and warps but little; lacks odor and taste; very strong for its weight; heartwood light brown	Limited in range to Pacific northwest; considered slightly heavier and weaker than northern white pine; often contains gum pockets
Tamarack	Wood is heavy, hard and strong; durable but considered less so than western larch; wood light brown in color	Resinous; sometimes defective (small knots, shakes, etc.); somewhat limited in size of stock produced

INDUSTRIAL USES FOR WOOD

This section represents a classification of a few of the important uses of wood, separated by industries or products and by species. The purpose is to acquaint lumber consumers with the modern use of commercially important species and the products in which they are found.

It is practically impossible to include here a complete classification of the four thousand or more specialized wood products, but further information is given in the chapters on each species.

The information shown in this section is based upon a survey of *Lumber Used in Manufacture—1928*, conducted by the Forest Service in coöperation with the Department of Agriculture and the Bureau of the Census. Data also has been secured from some of the regional lumber associations.

Airplane (bodies and parts)

Softwoods:

- Cedar:
  - Port Orford
  - western red
- Fir, Douglas
- Pine:
  - northern white
  - Pondosa
  - sugar
  - southern yellow
- Spruce:
  - eastern
  - Sitka

Hardwoods:

- Ash
- Balsa
- Basswood
- Birch
- Chestnut
- Elm
- Hickory
- Maple
- Oak, red and white
- Poplar, yellow

Airplane (propellers)

Hardwoods:

- Walnut, Black

Auto Bodies (frames)

Softwoods:

- Cypress
- Pine, southern yellow

Hardwoods:

- Ash
- Basswood
- Elm
- Gum:
  - red
  - tupelo
- Magnolia
- Poplar, yellow
- Oak, red and white

Auto Bodies (trim)

Hardwoods:

- Birch
- Cabinet woods, tropical
- Mahoganies
- Walnut, black

Baskets and Fruit Packages

Softwoods:

- Cedar:
  - northern
  - southern
- Cypress
- Fir, Douglas
- Hemlock:
  - eastern
  - West Coast
- Pine:
  - Idaho white
  - northern white
  - Pondosa
  - southern yellow
  - sugar
- Redwood
- Spruce:
  - eastern
  - Sitka

Hardwoods:

- Ash
- Basswood
- Beech
- Birch
- Cherry
- Cottonwood
- Elm
- Gum:
  - red
  - tupelo
- Hickory
- Maple, soft
- Oak, red and white
- Persimmon
- Poplar, yellow
- Sycamore
- Willow

Batteries (boxes)

Softwoods:

- Cedar, western red
- Cypress
- Redwood

Hardwoods:

- Ash
- Beech
- Birch
- Cottonwood
- Elm
- Gum:
  - red
  - tupelo
- Magnolia
- Maple, soft
- Poplar, yellow
- Sycamore

Batteries (separators)

Softwoods:

Cedar, Port Orford
Redwood

Beehives

Softwoods:

Cedar, western red
Cypress
Pine:
northern white
sugar
Redwood

Hardwoods:

Basswood
Poplar, yellow

Blinds, Venetian

Softwoods:

Cedar, Port Orford
Cypress, red
Redwood

Hardwoods:

Cottonwood
Poplar, yellow

Blocks, Pulley

Softwoods:

Pine, southern yellow

Hardwoods:

Ash
Basswood
Beech
Birch
Gum:
red
tupelo
Maple, hard and soft
Oak, red and white
Poplar, yellow

Bobbins, Shuttles and Spools

Softwoods:

Pine, northern white

Hardwoods:

Ash
Basswood
Beech
Birch
Dogwood
Gum, red
Hickory
Maple
Oak, red and white
Persimmon
Poplar, yellow
Sycamore

Boxes and Crates

Softwoods:

Cedar:
incense
northern white
Port Orford
southern white
western red
Cypress
Fir, Douglas
Hemlock:
eastern
West Coast
Larch, western
Pine:
Idaho white
northern white
Pondosa
southern yellow
sugar
Redwood
Spruce:
eastern
Sitka
Tamarack, eastern

Hardwoods:

Alder
Ash
Basswood
Beech
Birch
Buckeye
Butternut
Chestnut
Cottonwood
Elm
Gum:
red
tupelo
Hickory
Magnolia
Maple, soft and hard
Poplar, yellow
Sycamore
Willow

Boxes, Auto Export

Softwoods:

Cypress
Fir, Douglas
Hemlock:
eastern
West Coast
Pine:
Idaho white
northern white
Pondosa
southern yellow
sugar
Redwood
Spruce:
eastern
Sitka

Hardwoods:

Ash
Beech
Birch
Chestnut
Cottonwood
Gum:
red
tupelo
Maple, soft
Poplar, yellow

Boxes, Tobacco and Cigar

Softwoods:

Fir, Douglas
Pine:
northern white
Pondosa
Redwood
Spruce, eastern
Sitka

Hardwoods:

Basswood
Cedar, Spanish
Cottonwood
Elm
Gum:
red
tupelo
Hardwood, Philippine
Magnolia
Mahoganies
Poplar, yellow

Brooms and Carpet Sweepers

Softwoods:

Hemlock:
eastern
western
Pine:
northern white
Pondosa
southern yellow

Hardwoods:

Ash
Basswood
Beech
Birch
Gum:
red
tupelo
Hickory
Maple, hard

Brushes

Softwoods:

Cedar, western red
Cypress
Pine:
northern white
Pondosa
southern yellow

Hardwoods:
- Alder
- Ash
- Basswood
- Beech
- Birch
- Cottonwood
- Dogwood
- Elm
- Gum, red
- Hickory
- Maple
- Persimmon
- Poplar, yellow
- Rosewood
- Sycamore
- Walnut, black

Bungs and Faucets

Softwoods:
- Pine:
  - northern white
  - southern yellow

Hardwoods:
- Birch
- Butternut
- Gum, red
- Maple:
  - hard
  - soft
- Poplar, yellow

Butchers' Blocks and Skewers

Softwoods:
- Pine:
  - northern white
  - southern yellow

Hardwoods:
- Beech
- Birch
- Gum, black
- Hickory
- Maple, hard
- Sycamore

Cabinets, Kitchen

Softwoods:
- Cedar, western red
- Cypress
- Hemlock, West Coast
- Pine:
  - northern white
  - Pondosa
  - southern yellow
  - sugar
- Redwood
- Spruce, Sitka

Hardwoods:
- Basswood
- Beech
- Birch
- Chestnut
- Elm, red and white
- Gum:
  - red
  - tupelo
- Oak, red and white
- Poplar, yellow
- Sycamore

Cabinets, Radio

Hardwoods:
- Birch
- Gum, red
- Mahoganies
- Maple
- Oak, red and white
- Poplar, yellow
- Tropical cabinet woods
- Walnut

Canoe Ribs and Braces

Softwoods:
- Cedar:
  - northern white
  - southern white
- Cypress
- Spruce, Sitka

Hardwoods:
- Ash
- Hickory

Cars, Railway (frames, ceiling, decking, paneling, etc.)

Softwoods:
- Cedar:
  - eastern red
  - northern white
  - southern white
  - western red
- Cypress, red
- Fir, Douglas
- Hemlock, West Coast
- Larch, western
- Pine:
  - northern white
  - Pondosa
  - southern yellow
- Redwood
- Spruce, Sitka

Hardwoods:
- Ash
- Basswood
- Beech
- Birch
- Buckeye
- Cedar, Spanish
- Cherry
- Chestnut
- Cottonwood
- Elm
- Gum:
  - red
  - tupelo
- Hardwood, Philippine
- Hickory
- Mahoganies
- Maple, hard
- Oak, red and white
- Padauk
- Poplar, yellow
- Teak
- Walnut, black

Caskets and Coffins

Softwoods:
- Cedar:
  - eastern red
  - northern white
  - southern white
  - western red
- Cypress, red
- Fir, Douglas
- Hemlock, West Coast
- Pine:
  - northern white
  - Pondosa
  - southern yellow
- Redwood
- Spruce, Sitka

Hardwoods:
- Ash
- Basswood
- Beech
- Birch
- Buckeye
- Butternut
- Cherry
- Chestnut
- Cottonwood
- Elm
- Gum:
  - red
  - tupelo
- Hardwood, Philippine
- Mahoganies
- Maple
- Oak, red and white
- Poplar, yellow
- Walnut, black

Chairs and Chair Stock

Softwoods:
- Cypress
- Fir, Douglas
- Pine, southern yellow

Hardwoods:
- Alder
- Basswood
- Beech
- Birch, yellow
- Cherry
- Chestnut
- Cottonwood
- Elm, rock and white
- Gum:
  - red
  - tupelo
- Hardwood, Philippine
- Hickory
- Mahoganies

Maple, hard
Oak, red and white
Pecan
Poplar, yellow
Sycamore
Walnut, black

Chests, Moth-proof

Softwoods:
Cedar:
eastern red
incense
northern white
Port Orford
southern white

Clocks

Softwoods:
Pine:
northern white
sugar
Spruce, eastern

Hardwoods:
Basswood
Birch, yellow
Cherry
Chestnut
Gum:
red
tupelo
Mahoganies
Oak, red and white
Poplar, yellow
Walnut, black

Closet Lining

Softwoods:
Cedar:
eastern red
incense
northern white
Port Orford
southern white
western red

Clothespins

Softwoods:
Spruce, eastern

Hardwoods:
Beech
Birch
Gum, tupelo
Magnolia

Clothes Racks

Softwoods:
Cedar, western red
Fir, Douglas
Hemlock, West Coast
Pine:
northern white
Pondosa
southern yellow
sugar
Redwood
Spruce

Hardwoods:
Beech
Cottonwood
Gum:
red
tupelo
Magnolia
Maple, soft
Poplar, yellow

Construction, Machine

Softwoods:
Cedar, western red
Cypress
Fir, Douglas
Hemlock:
eastern
West Coast
Pine:
northern white
Pondosa
southern yellow
Redwood
Spruce:
eastern
Sitka

Hardwoods:
Ash
Basswood
Birch
Chestnut
Cottonwood
Gum:
red
tupelo
Hickory
Maple, hard and soft
Oak, red and white
Poplar, yellow

Containers, Butter

Softwoods:
Pine:
northern white
Sugar
Spruce:
eastern
Sitka

Hardwoods:
Basswood
Cottonwood
Poplar, yellow

Containers, Plywood

Softwoods:
Cypress, red
Fir, Douglas
Hemlock, West Coast
Pine:
Idaho white
northern white
Pondosa
southern yellow
sugar
Redwood
Spruce:
eastern
Sitka

Hardwoods:
Ash
Basswood
Cottonwood
Gum, red and "sap"

Containers, Shipping

Softwoods:
Cypress
Fir, Douglas
Hemlock, West Coast
Pine:
Idaho white
northern white
Pondosa
southern yellow
sugar
Redwood
Spruce:
eastern
Sitka

Hardwoods:
Basswood
Cottonwood
Gum:
red and "sap"
tupelo and black
Poplar, yellow

Core Stock

Softwoods:
Cedar, western red
Fir, Douglas
Hemlock, West Coast
Redwood
Spruce:
Port Orford
Sitka

Hardwoods:
Ash
Chestnut
Oak, red and white
Poplar, yellow

Dairyman's, Poultryman's, and Apiarist's Supplies

Softwoods:
Cedar, western red
Cypress
Fir, Douglas
Hemlock:
eastern
West Coast

Pine:
northern white
Pondosa
southern yellow
sugar
Redwood
Spruce:
eastern
Sitka

Hardwoods:

Ash
Basswood
Beech
Birch
Chestnut
Cottonwood
Elm
Gum:
red
tupelo
Hickory
Maple, soft
Oak, red and white
Poplar, yellow

Dimension, Structural

Softwoods:

Fir, Douglas
Pine, southern yellow
Redwood

Dowels

Softwoods:

Fir, Douglas
Pine:
northern white
sugar

Hardwoods:

Ash
Beech
Birch
Elm
Hickory
Maple, hard
Oak

Drainboards

Softwoods:

Cedar:
Port Orford
western red
Fir, Douglas
Pine:
Idaho white
northern white
southern yellow
sugar
Spruce, Sitka

Hardwoods:

Poplar, yellow

Elevators, Freight and Passenger

Softwoods:

Cypress
Fir, Douglas
Pine, southern yellow

Hardwoods:

Ash
Basswood
Maple
Oak
Sycamore

Equipment, Playground (swings, bars, etc.)

Softwoods:

Fir, Douglas
Hemlock:
eastern
West Coast
Pine:
northern white
Pondosa
southern yellow

Hardwoods:

Ash
Basswood
Beech
Birch
Elm
Gum, red
Hickory
Maple
Oak, red and white

Excelsior

Softwoods:

Pine:
northern white
southern yellow
Tamarack

Hardwoods:

Basswood
Cottonwood
Poplar, yellow

Fencing and Pickets

Softwoods:

Cedar:
Port Orford
western red
Cypress
Fir, Douglas
Hemlock:
eastern
West Coast
Pine:
Idaho white
northern white
Pondosa
southern yellow
sugar
Redwood
Spruce:
eastern
Sitka

Hardwoods:

Chestnut
Poplar, yellow

Findings, Boot and Shoe

Softwoods:

Fir, Douglas
Pine, northern white

Hardwoods:

Basswood
Beech
Birch
Maple, hard
Persimmon
Poplar, yellow

Finish, Exterior

Softwoods:

Cedar:
Port Orford
western red
Cypress, red
Fir, Douglas
Hemlock, West Coast
Larch, western
Pine:
Idaho white
Pondosa
southern yellow
sugar
Redwood
Spruce, Sitka

Finish, Interior

Softwoods:

Cedar:
Port Orford
western red
Cypress, red
Fir, Douglas
Hemlock, West Coast
Larch, western
Pine:
Idaho
northern white
Pondosa
southern yellow
sugar
Redwood
Spruce, Sitka

Hardwoods:

Chestnut
Mahoganies
Oak, red and white
Poplar, yellow
Tropical cabinet wood
Walnut, black

Fixtures, Home and Office

Softwoods:
- Cedar:
  - Port Orford
  - western red
- Cypress, red
- Fir, Douglas
- Hemlock, West Coast
- Larch, western
- Pine:
  - Idaho white
  - northern white
  - Pondosa
  - southern yellow
  - sugar
- Spruce, Sitka

Hardwoods:
- Alder
- Ash
- Basswood
- Beech
- Birch, yellow
- Buckeye
- Butternut
- Cherry
- Chestnut
- Cottonwood
- Elm
- Gum:
  - red
  - tupelo
- Hardwood, Philippine
- Hickory
- Mahoganies
- Maple
- Oak, red and white
- Padauk
- Pecan
- Poplar
- Sycamore
- Teak
- Tropical cabinet wood
- Walnut:
  - black
  - Circassian
- Willow

Flooring, Interior

Softwoods:
- Cypress
- Fir, Douglas
- Hemlock:
  - eastern
  - West Coast
- Larch, western
- Pine:
  - Pondosa
  - southern yellow
  - sugar

Hardwoods:
- Beech
- Birch
- Maple, hard
- Oak, red and white

Flooring, Porch

Softwoods:
- Cypress
- Fir, Douglas
- Hemlock:
  - eastern
  - West Coast
- Larch, western
- Pine:
  - Idaho
  - northern white
  - Pondosa
  - southern yellow
  - sugar
- Redwood

Floors, Sub

Softwoods:
- Cedar, western red
- Cypress, red
- Fir, Douglas
- Hemlock:
  - eastern
  - West Coast
- Larch, western
- Pine:
  - Idaho
  - northern white
  - Pondosa
  - southern yellow
  - sugar
- Redwood
- Spruce:
  - eastern
  - Sitka
- Tamarack

Flumes, Water

Softwoods:
- Cedar, western red
- Cypress
- Fir, Douglas
- Larch, western
- Redwood

Frames and Molding, Picture

Softwoods:
- Cedar, western red
- Fir, Douglas
- Pine:
  - Idaho
  - northern white
  - Pondosa
  - southern yellow
  - sugar
- Redwood
- Spruce:
  - eastern
  - Sitka

Hardwoods:
- Basswood
- Birch
- Cherry
- Chestnut
- Gum, red
- Mahoganies
- Maple, soft
- Oak, white and red
- Poplar, yellow
- Walnut, black

Framing, Structural

Softwoods:
- Cypress
- Fir, Douglas
- Hemlock:
  - eastern
  - West Coast
- Larch, western
- Pine:
  - Idaho white
  - northern white
  - Pondosa
  - southern yellow
  - sugar
- Redwood
- Spruce:
  - eastern
  - Sitka

Furniture, Household

Softwoods:
- Cedar:
  - Port Orford
  - western red
- Fir, Douglas
- Hemlock, West Coast
- Pine:
  - Idaho white
  - northern white
  - Pondosa
  - southern yellow
  - sugar
- Redwood
- Spruce:
  - eastern
  - Port Orford
  - Sitka

Hardwoods:
- Alder
- Ash, white
- Birch, yellow
- Buckeye
- Cherry
- Cottonwood
- Elm, white and red
- Gum:
  - red
  - tupelo
- Hickory
- Mahoganies
- Maple, hard and soft
- Oak, red and white
- Pecan
- Poplar, yellow
- Sycamore
- Tropical cabinet woods
- Walnut, black
- Willow

Furniture, Office

Softwoods:
- Fir, Douglas
- Pine:
  - northern white
  - Pondosa
  - southern yellow
- Redwood
- Spruce:
  - eastern
  - Sitka

Hardwoods:
- Ash
- Cherry
- Elm
- Gum, red
- Mahoganies
- Maple, hard
- Oak, red and white
- Poplar, yellow
- Tropical cabinet woods
- Walnut, black

Furniture, Outdoor

Softwoods:
- Cedar:
  - Port Orford
  - western red
- Cypress
- Pine:
  - northern white
  - Pondosa
  - southern yellow
  - sugar
- Redwood
- Spruce:
  - eastern
  - Sitka

Hardwoods:
- Birch, yellow
- Chestnut
- Oak, white
- Poplar, yellow
- Willow

Gates, Farm

Softwoods
- Cedar, western red
- Cypress
- Hemlock:
  - eastern
  - West Coast
- Pine:
  - Idaho white
  - northern white
  - Pondosa
  - southern yellow
  - sugar
- Redwood

Hardwoods:
- Beech
- Chestnut
- Oak, white and red
- Poplar, yellow

Golf Heads

Hardwoods:
- Dogwood
- Persimmon

Golf Shafts

Hardwoods:
- Ash
- Hickory

Greenhouses

Softwoods:
- Cedar:
  - Port Orford
  - western red
- Cypress
- Pine:
  - northern white
  - southern yellow
  - sugar
- Redwood

Gun Stocks

Hardwoods:
- Birch
- Gum, red
- Walnut, black

Handles, General

Softwoods:
- Fir, Douglas
- Pine:
  - Pondosa
  - southern yellow
  - spruce, eastern
  - Sitka

Hardwoods:
- Ash
- Basswood (paint brush)
- Beech (paint brush)
- Birch, yellow
- Cherry
- Elm
- Gum:
  - red
  - black and tupelo
- Hardwoods, Philippine
- Hickory
- Maple, hard
- Oak, red and white
- Poplar, yellow
- Rosewoods
- Sycamore
- Walnut, black

Handles, Tool

Softwoods:
- Fir, Douglas
- Pine, southern yellow

Hardwoods:
- Ash, white
- Boxwood
- Cherry
- Cocobola
- Dogwood
- Ebony
- Elm
- Hickory
- Maple, hard
- Persimmon

Heading (slack and tight)

Softwoods:
- Fir, Douglas
- Hemlock:
  - eastern
  - West Coast
- Pine:
  - northern white
  - southern yellow
- Spruce:
  - eastern
  - Sitka

Hardwoods:
- Ash
- Basswood
- Beech
- Birch
- Elm
- Gum, red
- Maple, soft
- Oak
- Tupelo

Hoops

Hardwoods:
- Ash, white
- Elm, white
- Oak
- Pine, southern yellow

Implements and Supplies, Agricultural

Softwoods:
- Cedar, western red
- Cypress, red
- Fir, Douglas
- Hemlock, West Coast
- Pine:
  - northern white
  - Pondosa
  - southern yellow
  - sugar
- Redwood
- Spruce, eastern
  - Sitka

Hardwoods:
- Ash, white
- Basswood
- Beech
- Birch
- Chestnut
- Cottonwood
- Elm, red and white
- Gum, red
- Hickory

Maple, hard
Oak, red and white
Poplar, yellow
Sycamore
Tupelo

Instruments, Musical

Softwoods:
Cedar, western
Cypress
Fir, Douglas
Hemlock:
eastern
West Coast
Pine:
Idaho
northern white
Pondosa
southern yellow
sugar
Spruce:
eastern
Sitka

Hardwoods:
Ash
Basswood
Beech
Birch, yellow
Boxwood
Butternut
Cherry
Chestnut
Cocobola
Cottonwood
Elm
Hardwood, Philippine
Hickory
Mahogany
Maple, hard
Oak, red and white
Poplar, yellow
Rosewood
Walnut, black

Instruments, Scientific

Softwoods:
Cedar, western red
Cypress
Fir, Douglas
Pine:
Idaho
northern white
southern yellow
sugar
Redwood
Spruce, eastern

Hardwoods:
Ash
Basswood
Beech
Birch
Cherry
Chestnut
Dogwood
Elm
Gum, red
Hardwood, Philippine
Hickory
Oak, red and white
Poplar, yellow
Rosewood
Satinwood
Teak
Tupelo
Walnut:
black
Circassian

Ironing Boards

Softwoods:
Cedar:
Port Orford
western red
Pine:
Idaho white
northern white
Pondosa
southern yellow
sugar
Spruce, Sitka

Hardwoods:
Basswood
Beech
Birch
Gum:
red
tupelo
Poplar, yellow
Sycamore

Ladders, Extension

Softwoods:
Pine:
Idaho white
northern white
Pondosa
sugar
Spruce:
eastern
Sitka

Hardwoods:
Poplar, yellow

Ladders, Step

Softwoods:
Hemlock, West Coast
Pine:
Idaho white
northern white
sugar
Spruce:
eastern
Sitka

Lath

Softwoods:
Cedar, western red
Cypress
Fir, Douglas
Hemlock, West Coast
Pine:
Idaho white
northern white
Pondosa
southern yellow
sugar
Redwood
Spruce:
eastern
Sitka

Hardwoods:
Basswood
Cottonwood
Gum:
red
tupelo
Poplar, yellow

Lattice Work

Softwoods:
Cedar:
Port Orford
western red
Cypress
Pine:
northern white
southern yellow
sugar
Redwood

Limbs, Artificial

Hardwoods:
Ash
Basswood
Beech
Birch
Buckeye
Maple
Willow

Machines, Sewing

Softwoods:
Pine:
northern white
southern yellow

Hardwoods:
Basswood
Beech
Birch
Chestnut
Elm
Gum, red
Mahoganies
Maple, hard and soft
Oak, red and white
Pecan
Poplar, yellow
Tupelo
Walnut, black

Matches

Softwoods:
- Pine:
  - Idaho white
  - northern white
  - sugar

Hardwoods:
- Alder
- Basswood

Millwork, General

Softwoods:
- Cedar:
  - Port Orford
  - western red
- Cypress
- Fir, Douglas
- Hemlock:
  - eastern
  - West Coast
- Larch, western
- Pine:
  - Idaho white
  - northern white
  - Pondosa
  - southern yellow
  - sugar
- Redwood
- Spruce:
  - eastern
  - Sitka
- Tamarack, eastern

Hardwoods:
- Ash, white
- Birch, yellow
- Chestnut
- Cottonwood
- Gum, red
- Hardwood, Philippine
- Magnolia
- Mahogany
- Maple, hard
- Oak, red and white
- Poplar, yellow
- Sycamore
- Teak
- Walnut:
  - black
  - Circassian

Molding, House

Softwoods:
- Cedar:
  - Port Orford
  - western red
- Cypress, red
- Hemlock, West Coast
- Pine:
  - Idaho white
  - northern white
  - Pondosa
  - southern yellow
  - sugar
- Spruce, Sitka

Hardwoods:
- Basswood
- Poplar, yellow

Moldings, Picture

Softwoods:
- Hemlock, West Coast
- Pine:
  - northern white
  - Pondosa
  - sugar
- Spruce:
  - eastern
  - Sitka

Hardwoods:
- Basswood
- Birch
- Cherry
- Chestnut
- Hardwoods, Philippine
- Mahogany
- Poplar, yellow
- Walnut, black

Molds, General

Softwoods:
- Pine:
  - northern white
  - sugar
- Spruce:
  - eastern
  - Sitka

Hardwoods:
- Basswood
- Cherry
- Cottonwood
- Gum:
  - red
  - tupelo
- Maple, hard and soft
- Poplar, yellow
- Sycamore

Musical Wood Valves

Softwoods:
- Spruce, Sitka

Hardwoods:
- Gum, red

Novelties, Turned Wood

Softwoods:
- Cedar:
  - Port Orford
  - eastern red
  - western red
- Cypress
- Fir, Douglas
- Hemlock:
  - eastern
  - West Coast
- Pine:
  - Idaho white
  - northern white
  - Pondosa
  - southern yellow
  - sugar
- Spruce:
  - eastern
  - Sitka

Hardwoods:
- Alder
- Ash
- Basswood
- Beech
- Birch, yellow
- Cherry
- Chestnut
- Cocobola
- Cottonwood
- Ebony
- Gum:
  - red
  - tupelo
- Hardwoods, Philippine
- Holly
- Lignum vitæ
- Magnolia
- Oak, red and white
- Poplar, yellow
- Rosewood
- Walnut, black

Oars, Racing and Paddles

Softwoods:
- Spruce:
  - eastern
  - Sitka

Organ Pipes

Softwoods:
- Spruce, Sitka

Parquet

Hardwoods:
- Cherry
- Maple, hard
- Oak, red and white
- Walnut, black

Patterns and Flasks

Softwoods:
- Cedar, western red
- Fir, Douglas
- Hemlock, eastern
- Pine:
  - Idaho white
  - northern white
  - Pondosa
  - southern yellow
  - sugar
- Redwood
- Spruce:
  - eastern
  - Sitka

Hardwoods:
- Ash
- Basswood
- Beech
- Birch
- Butternut
- Cherry
- Chestnut
- Elm
- Maple
- Oak
- Poplar, yellow
- Walnut, black

Paving Blocks

Softwoods:
- Fir, Douglas
- Larch, western
- Pine, southern yellow
- Redwood
- Tamarack, eastern

Pencils and Pencil Slats

Softwoods:
- Cedar:
  - eastern red
  - incense

Phonographs

Hardwoods:
- Birch
- Chestnut
- Gum, red
- Mahoganies
- Maple
- Oak, red and white
- Poplar, yellow
- Walnut, black

Piling

Softwoods:
- Cedar:
  - Port Orford
  - western red
- Cypress
- Fir, Douglas
- Larch, western
- Pine, southern yellow
- Redwood

Hardwoods:
- Chestnut
- Oak, white and red

Pipe, Wood

Softwoods:
- Cedar, western red
- Cypress
- Fir, Douglas
- Redwood

Pipes, Tobacco

Hardwoods:
- Applewood
- Hickory
- Maple

Plane Stock

Hardwoods:
- Dogwood
- Persimmon

Plank, Bridge

Softwoods
- Cedar:
  - Port Orford
  - western red
- Cypress
- Fir, Douglas
- Redwood

Hardwoods:
- Beech
- Birch
- Gum, tupelo
- Maple, hard
- Oak, red and white

Poles

Softwoods:
- Cedar:
  - incense
  - northern white
  - Port Orford
  - southern white
  - western red
- Cypress
- Fir, Douglas
- Pine:
  - northern white
  - southern yellow
- Redwood
- Tamarack, eastern

Hardwoods:
- Chestnut
- Oak, red and white

Posts

Softwoods
- Cedar:
  - eastern red
  - incense
  - northern white
  - Port Orford
  - southern white
  - western red
- Fir, Douglas
- Pine:
  - northern white
  - southern yellow
- Redwood
- Tamarack, eastern

Hardwoods:
- Chestnut
- Oak, white

Pulleys and Conveyors

Softwoods:
- Pine, southern yellow
- Spruce:
  - eastern
  - Sitka

Hardwoods:
- Basswood
- Beech
- Birch
- Elm
- Gum:
  - red
  - tupelo
- Poplar, yellow
- Sycamore

Pulp

Softwoods:
- Fir, Douglas
- Hemlock, West Coast
- Pine:
  - Idaho white
  - northern white
  - Pondosa
  - southern yellow
  - sugar
- Spruce:
  - eastern
  - Sitka

Hardwoods:
- Alder
- Basswood
- Chestnut
- Elm
- Maple, soft
- Poplar, yellow

Racing Shells and Boats

Softwoods:
- Cedar, western red
- Spruce, Sitka

Refrigerators

Softwoods:
- Cedar, western red
- Fir, Douglas
- Hemlock:
  - eastern
  - West Coast
- Pine:
  - northern white
  - southern yellow
  - sugar
- Redwood
- Spruce, eastern

Hardwoods:
- Ash
- Birch
- Chestnut
- Gum, red
- Maple, soft and hard
- Oak

Rollers, General

Softwoods:
- Fir, Douglas
- Pine, southern yellow

Hardwoods:
- Beech
- Birch
- Dogwood
- Gum, tupelo
- Maple, hard
- Oak, red and white
- Persimmon
- Sycamore

Rollers, Shade and Map

Softwoods:
- Cedar, western red
- Fir, Douglas
- Pine:
  - northern white
  - Pondosa
  - southern yellow
  - sugar
- Spruce:
  - eastern
  - Sitka

Hardwoods:
- Ash
- Basswood
- Beech
- Birch
- Gum:
  - red
  - tupelo
- Poplar, yellow

Rulers

Hardwoods:
- Boxwood
- Maple, hard

Saddlery

Softwoods:
- Fir, Douglas
- Pine:
  - Pondosa
  - southern yellow
- Spruce, Sitka

Hardwoods:
- Ash
- Basswood
- Beech
- Birch
- Elm
- Gum
- Maple
- Oak
- Poplar, yellow

Sash and Doors

Softwoods:
- Cedar:
  - Port Orford
  - western red
- Cypress
- Fir, Douglas
- Hemlock, West Coast
- Larch, western
- Pine:
  - Idaho white
  - northern white
  - Pondosa
  - southern yellow
  - sugar
- Redwood
- Spruce, Sitka
- Tamarack

Hardwoods:
- Cherry
- Cottonwood
- Gum:
  - red
  - tupelo
- Mahoganies
- Maple, hard and soft
- Oak
- Poplar, yellow
- Walnut:
  - black
  - Circassian

Screens

Softwoods:
- Cedar:
  - Port Orford
  - western red
- Cypress
- Fir, Douglas
- Hemlock, West Coast
- Pine:
  - Idaho white
  - northern white
  - Pondosa
  - southern yellow
  - sugar
- Redwood
- Spruce:
  - eastern
  - Sitka

Hardwoods:
- Basswood
- Cottonwood
- Maple, soft
- Poplar, yellow

Sheathing

Softwoods:
- Cedar, western red
- Cypress, red
- Fir, Douglas
- Hemlock, West Coast
- Pine:
  - Idaho white
  - northern white
  - Pondosa
  - southern yellow
  - sugar
- Redwood
- Spruce:
  - eastern
  - Sitka

Hardwoods:
- Chestnut
- Poplar, yellow

Shelving

Softwoods:
- Cedar, western red
- Cypress
- Fir, Douglas
- Hemlock, West Coast
- Pine:
  - Idaho white
  - northern white
  - Pondosa
  - southern yellow
  - sugar
- Redwood
- Spruce, eastern

Hardwoods:
- Basswood
- Birch
- Cottonwood
- Maple
- Oak, red and white

Shingles

Softwoods:
- Cedar:
  - northern white
  - Port Orford
  - southern white
  - western red
- Cypress
- Pine:
  - Pondosa
  - southern yellow
  - sugar
- Redwood

Ship Decking

Softwoods:
- Cedar, western red
- Cypress
- Fir, Douglas
- Pine:
  - northern white
  - southern yellow
- Redwood

Hardwoods:
- Balsa
- Chestnut
- Hardwoods, Philippine
- Mahoganies
- Maple, hard
- Oak, red and white
- Poplar, yellow

Ship-lap

Softwoods:
- Cedar, western red
- Cypress
- Fir, Douglas
- Hemlock, West Coast

Larch, western
Pine:
northern white
Pondosa
southern yellow
sugar
Redwood
Spruce:
eastern
Sitka

Ship Planking

Softwoods:
Cedar:
northern white
southern white
western red
Cypress
Fir, Douglas
Pine:
northern white
Pondosa
southern yellow
Redwood
Spruce, eastern
Sitka

Hardwoods:
Cedar, Spanish
Chestnut
Gum, red
Hardwoods, Philippine
Mahoganies
Maple, hard
Oak, red and white
Poplar, yellow

Ship Timbers

Softwoods:
Cedar, eastern red
Fir, Douglas
Larch, western
Pine, southern yellow
Redwood

Hardwoods:
Ash
Hickory
Oak, red and white
Teak

Siding (drop, rustic, bevel)

Softwoods:
Cedar, western red
Cypress
Fir, Douglas
Hemlock:
eastern
West Coast
Larch, western
Pine:
Idaho white
northern white
Pondosa
southern yellow
sugar
Redwood
Spruce:
eastern
Sitka

Hardwoods:
Poplar, yellow

Signs

Softwoods:
Cedar:
Port Orford
western red
Cypress
Fir, Douglas
Larch, western
Pine:
Idaho white
northern white
Pondosa
southern yellow
sugar
Redwood
Spruce, eastern

Hardwoods:
Basswood
Birch
Chestnut
Cottonwood
Gum, red
Poplar, yellow

Silos

Softwoods:
Cedar, western red
Cypress
Fir, Douglas
Hemlock, West Coast
Pine, southern yellow
Redwood

Hardwoods:
Poplar, yellow

Skis

Hardwoods:
Ash
Hickory
Maple, hard

Sounding Boards

Softwoods:
Spruce:
eastern
Sitka

Spokes

Hardwoods:
Ash
Hickory
Oak, red and white

Sporting Goods

Softwoods:
Cedar:
eastern red
northern white
southern white
Fir, Douglas
Pine:
northern white
southern yellow
Redwood
Spruce:
eastern
Sitka

Hardwoods:
Ash
Basswood
Beech
Birch
Cedar, Spanish
Elm
Gum:
red
tupelo
Hickory
Mahoganies
Maple
Oak
Persimmon
Poplar, yellow
Sycamore
Walnut, black

Staves, Slack

Softwoods:
Cypress, red
Fir, Douglas
Hemlock, West Coast
Pine:
Pondosa
southern yellow
Redwood
Spruce:
eastern
Sitka

Hardwoods:
Ash
Cottonwood
Elm
Gum:
red
tupelo
Oak, red and white
Poplar, yellow

Staves, Tight

Softwoods:
Fir, Douglas
Hemlock
Pine:
northern white
southern yellow
Spruce

Hardwoods:
- Ash
- Basswood
- Birch
- Chestnut
- Cottonwood
- Gum, red
- Oak, white

Tables, Billiard

Hardwoods:
- Birch
- Mahoganies
- Maple, hard
- Walnut, black

Tables, Folding Card

Softwoods:
- Cedar, Port Orford
- Cypress
- Fir, Douglas
- Pine:
  - Idaho white
  - northern white
  - Pondosa
  - southern yellow
  - sugar
- Redwood

Hardwoods:
- Alder
- Basswood
- Beech
- Birch
- Cottonwood
- Gum:
  - red
  - tupelo
- Maple, hard and soft

Tanks, Acid

Softwoods:
- Cedar:
  - northern white
  - southern white
- Cypress
- Fir, Douglas
- Redwood

Hardwoods:
- Chestnut
- Oak, white
- Poplar, yellow

Tanks, Water

Softwoods:
- Cedar:
  - northern white
  - southern white
  - western red
- Cypress
- Fir, Douglas
- Hemlock, West Coast
- Larch, western
- Pine:
  - northern white
  - Pondosa
  - southern yellow
- Redwood
- Tamarack, eastern

Hardwoods:
- Chestnut
- Maple, hard
- Oak, white and red
- Poplar, yellow

Tannin

Softwoods:
- Hemlock, eastern

Hardwoods:
- Chestnut
- Oak

Telephone Equipment

Softwoods:
- Cypress
- Hemlock, West Coast
- Pine:
  - northern white
  - Pondosa
  - southern yellow
  - sugar
- Spruce, eastern

Hardwoods:
- Beech
- Birch
- Locust
- Maple, hard and soft
- Oak, red and white
- Poplar, yellow
- Walnut, black

Ties, Cross and Switch

Softwoods:
- Cedar:
  - incense
  - northern white
  - Port Orford
  - southern white
  - western red
- Cypress, red
- Fir, Douglas
- Hemlock, West Coast
- Larch, western
- Pine:
  - Idaho white
  - Pondosa
  - southern yellow
- Redwood
- Tamarack

Hardwoods:
- Beech
- Birch, yellow
- Elm
- Gum, red
- Maple
- Oak, red and white
- Poplar, yellow

Timbers, Heavy

Softwoods:
- Cypress, red
- Fir, Douglas
- Hemlock, West Coast
- Larch, western
- Pine, southern yellow
- Redwood

Hardwoods:
- Chestnut
- Oak, red and white
- Poplar, yellow

Timbers, Mine

Softwoods:
- Cedar, western red
- Cypress, red
- Fir, Douglas
- Hemlock, West Coast
- Larch, Western
- Pine:
  - Pondosa
  - southern yellow
- Redwood
- Tamarack, eastern

Hardwoods:
- Beech
- Birch
- Chestnut
- Gum, red
- Maple, hard
- Oak, red and white

Toothpicks

Softwoods:
- Pine:
  - northern white
  - sugar

Hardwoods:
- Birch, white

Toys

Softwoods:
- Cedar, western red
- Fir, Douglas
- Hemlock:
  - eastern
  - West Coast
- Pine:
  - Idaho white
  - northern white
  - Pondosa
  - southern yellow
  - sugar
- Spruce:
  - eastern
  - Sitka

Hardwoods:
- Alder
- Ash
- Balsa
- Basswood
- Beech
- Birch
- Buckeye
- Cherry
- Chestnut
- Cottonwood
- Elm
- Gum:
  - red
  - tupelo
- Hickory
- Mahoganies
- Maple, hard and soft
- Oak, red and white
- Poplar, yellow
- Sycamore
- Walnut, black

Trellises

Softwoods:
- Cedar:
  - Port Orford
  - western red
- Cypress, red
- Fir, Douglas
- Pine:
  - Idaho white
  - northern white
  - Pondosa
  - southern yellow
  - sugar
- Redwood

Hardwoods:
- Poplar, yellow

Trim, Exterior

Softwoods:
- Cedar, western red
- Cypress, red
- Fir, Douglas
- Hemlock, West Coast
- Pine:
  - Idaho white
  - northern white
  - Pondosa
  - southern yellow
  - sugar
- Redwood
- Spruce, Sitka

Hardwoods:
- Poplar, yellow

Trim, Interior

Softwoods:
- Cedar:
  - Port Orford
  - western red
- Cypress, red
- Fir, Douglas
- Hemlock, West Coast
- Pine:
  - Idaho white
  - northern white
  - Pondosa
  - southern yellow
  - sugar
- Redwood
- Spruce:
  - eastern
  - Sitka

Hardwoods:
- Birch
- Chestnut
- Gum, red
- Poplar, yellow
- Walnut, black

Trunks and Trunk Slats

Softwoods:
- Cedar:
  - eastern red
  - western red
- Cypress
- Fir, Douglas
- Hemlock:
  - eastern
  - West Coast
- Pine:
  - northern white
  - Pondosa
  - southern yellow
  - sugar
- Spruce:
  - eastern
  - Sitka

Hardwoods:
- Basswood
- Birch
- Buckye
- Chestnut
- Cottonwood
- Elm
- Gum:
  - red
  - tupelo
- Maple, soft
- Poplar, yellow

Vehicles (non-motor)

Softwoods:
- Cypress
- Fir, Douglas
- Hemlock:
  - eastern
  - West Coast
- Pine:
  - northern white
  - Pondosa
  - southern yellow
- Redwood
- Spruce:
  - eastern
  - Sitka

Hardwoods:
- Ash
- Basswood
- Beech
- Birch
- Chestnut
- Cottonwood
- Elm
- Gum:
  - red
  - tupelo
- Hickory
- Mahoganies
- Maple
- Oak, red and white
- Pecan
- Poplar, yellow
- Sycamore

Veneers and Plywood

Softwoods:
- Cedar, Port Orford
- Cypress
- Fir, Douglas
- Hemlock, West Coast
- Pine:
  - Pondosa
  - southern yellow
  - sugar
- Redwood
- Spruce:
  - eastern
  - Sitka

Hardwoods:
- Ash
- Basswood
- Beech
- Birch, yellow
- Cottonwood
- Elm
- Gum:
  - red
  - tupelo
- Magnolia
- Mahogany, true and so-called
- Maple, hard and soft
- Oak, red and white
- Poplar, yellow
- Sycamore
- Tropical cabinet woods
- Walnut, black

Washboards

Softwoods:
- Cedar:
  - Port Orford
  - western red
- Pine:
  - northern white
  - Pondosa
  - sugar
- Spruce:
  - eastern
  - Sitka

Hardwoods:
- Basswood
- Beech
- Poplar, yellow

Weighing Apparatus

Softwoods:
- Hemlock:
  - eastern
  - West Coast
- Pine, northern white

Hardwoods:
- Oak, red and white

Wheels, Steering

Hardwoods:
- Birch
- Gum, red
- Maple, hard
- Walnut, black

Whips, Canes, Umbrella Sticks

Softwoods:
- Cedar:
  - northern white
  - southern white
- Redwood

Hardwoods:
- Ash
- Beech
- Birch
- Boxwood
- Cherry
- Cocobola
- Dogwood
- Ebony
- Gum:
  - red
  - tupelo
- Hickory
- Maple, hard
- Poplar, yellow
- Rosewood
- Snakewood
- Walnut, black

Woodenware

Softwoods:
- Hemlock, West Coast
- Pine:
  - Idaho white
  - northern white
  - Pondosa
  - southern yellow
  - sugar
- Redwood
- Spruce:
  - eastern
  - Sitka

Hardwoods:
- Alder
- Ash, white
- Balsa
- Basswood
- Birch
- Cherry
- Cottonwood
- Gum:
  - red
  - tupelo
- Hickory
- Maple, hard
- Poplar, yellow
- Willow

Woodwork, Plumber's

Softwoods:
- Pine, northern white

Hardwoods:
- Ash
- Beech
- Birch
- Cherry
- Chestnut
- Mahogany
- Maple, hard
- Oak, red and white
- Poplar, yellow
- Walnut, black

Yardsticks

Hardwoods:
- Basswood
- Poplar, yellow

INTRODUCTION TO SPECIES

(Commercially Important Woods)

American woods of commercial importance vary considerably both in their properties and in their uses. Approximately sixty species grow in the United States, each of which has a number of local names. If the wood for which you are looking is not given in the table of contents as a chapter heading, use the index at the back of the book.

The information in this book has been selected and condensed to meet the needs of purchasing agents and others who buy wood. Those who wish more facts than are given concerning any species can secure them from the books, periodicals, associations, and Governmental organizations to which reference is made.

HARDWOODS

(See Index for other names.)

RED ALDER[1]

(A Hardwood)

Alnus rubra

ANNUAL PRODUCTION (1928) ..... 13,254,000 bd. ft.
AVERAGE VALUE OF LUMBER CUT AT MILL PER M. B. F. (1928) $25.94
TIMBER STAND (1927) (Estimated) ..... 1,110,000,000 bd. ft.

PRINCIPAL STATES PRODUCING CUT—IN ORDER OF IMPORTANCE:

Oregon, Washington.

Range of Species

From southeastern Alaska (through islands and coast ranges of British Columbia, western Washington, and Oregon), to southern California (coast ranges to Santa Inex Mountains).

The increasing importance of red alder has become quite apparent within the last few years. In the West this is especially true, inasmuch as the desirable qualities of this wood make it valuable for use where other hardwoods are not so abundant and available. Its most important use is in the fabrication of furniture, and in other wood-using industries in the northwest.

Usual Name

Alder, red

Also Called

Alder (Calif., Ore.)
Red alder (Calif., Ore.)
Western or red alder
Oregon alder (Lit.)

Description

Alder belongs to the diffuse-porous group of hardwoods. There is little if any difference between the heartwood and sapwood. When the wood is freshly cut it is white, but upon exposure to air and light it slowly turns to a light reddish-brown. It somewhat resembles birch, although it is used to imitate walnut and mahogany.

The wood is fairly straight, fine, and of uniform grain. It is moderately light in weight, even grained, and fine textured, but it is not exceptionally strong as compared to oak and hickory.

[1] Red alder is the leading hardwood of the Pacific Northwest. It is cut mainly from this one species. However, there are several other species of alder.

It veneers well and takes glue and finish. If properly handled during seasoning it does not shrink, warp, or check. No great difficulty is experienced in air-seasoning or kiln-drying. No definite drying schedule is available for alder, but a schedule similar to that used for poplar, basswood, and cottonwood is being used successfully.

The wood is not especially resistant to decay. It is susceptible to staining if improperly piled and handled. It stays flat, and shrinks but slightly. It is difficult to bend.

Uses

Red alder's primary use is in the fabrication of furniture. It is veneered and manufactured into plywood and panel stock. It is also turned and carved extensively, and in the northwest it takes the place of gum for these purposes. Its most important uses are listed below:

Furniture
Chairs and chair stock
Woodenware and wood novelties
Paper plugs
Fixtures
Handles
Containers
Molding stock
Pulleys, rollers, toys, etc.

Classifications

Grading rules for red alder are given in Standard Inspection for Ash, Birch, Hard (or Sugar) Maple, Hackberry, Red Alder, and Sycamore, issued by the National Hardwood Lumber Association.

Consumers' individual grading rules covering bolts, logs, and sawed lumber are also in general use.

(See general list of Associations for addresses.)

Types and Sizes

In the West the large percentage of the stock is 8 to 12 feet long, much of it averaging around 8 feet. This is due to short logs which the tree produces. Thicknesses vary from 4/4 to 12/4 (mostly 4/4). The lumber is of random widths, from 4 inches to 12 inches, generally averaging 6 inches.

Generally, a small amount of FAS grades is produced, in proportion to the common grades produced.

The stock generally is kiln-dried at the fabricating plant just prior to its use.

Unit Packages

Many fabricators buy bolts and logs and cut them at their plants.

The lumber is sold largely on a mill or log run basis, measured on board feet tally. Often the stock is sold "live,"—sawed or "round-edged."

Shipping Weights

Alder logs generally weigh 7,000 to 8,000 pounds per thousand feet log scale. The approximate weights for rough lumber are given below:

TABLE 28

4/4 Green	4,000 to 5,000 lbs. per M.B.F.
4/4 Air-dried	3,000 to 3,400 lbs. per M.B.F.
4/4 Kiln-dried (8%)	2,250 to 2,500 lbs. per M.B.F.

Ordering

Give definite specifications as to allowable defects, stain, etc., particularly when the lumber is purchased under nonstandard grading rules.

The extreme limitation in sectional use of the species partly controls its purchase. (See, also, general discussion on Ordering.)

Caution

Alder is quite susceptible to stain and degrade (splitting), particularly in stock which is round-edged.

Pith flecks are common. Sometimes they will surface out while new ones develop as new surfaces of the wood become exposed. Frequently the wood contains white rot, black knots, "punk" streaks, etc.

Special Service Requirements

Red alder admirably meets the demand for a satisfactory hardwood for fabrication purposes in the Pacific northwest. Its outstanding features are that it is well suited for furniture fabrication because it turns or "shapes" well, takes finish exceptionally well, and is available for sectional use in abundant quantities.

Specifications

There are practically no specifications available for alder.

Engineering Data

(See Table 2.)

Improvements

Practically all red alder is circular-sawed by small mills. It is not any too well manufactured but meets the requirements of the consumers and fabricators.

Associations

The following associations can be consulted for information on red alder:

West Coast Lumbermen's Association (General information).

National Hardwood Lumber Association (National Grades).

(See general list of Associations for addresses.)

Publications

The following publications carry trade items regarding red alder, production, sources of supply, fabrication data, etc.:

Four L Lumber News

West Coast Lumberman

Western Wood Worker and Furniture Manufacturer

(See general list of Periodicals for publishers' addresses.)

Bibliography

The following books and articles may prove helpful to readers desiring further information:

Red Alder of the Pacific Northwest—H. M. Jolman, Edward S. Hanzlik, and William H. Gibbons.

American Forest Trees—Henry H. Gibson.

(See general Bibliography for publishers' addresses.)

Abbreviations and Terminology

Red alder is generally referred to as alder, and is seldom abbreviated.

(See general list of Abbreviations and Glossary.)

THE ASHES[1]

(Hardwoods)

WHITE ASH
Fraxinus americana

BLACK ASH
Fraxinus nigra

GREEN ASH
Fraxinus pennsylvanica lanceolata

RED ASH
Fraxinus pennsylvanica

OREGON ASH
Fraxinus oregona

ANNUAL PRODUCTION (1928).....130,099,000 bd. ft.
AVERAGE VALUE OF LUMBER CUT AT MILL PER M.B.F. (1928) $45.62
TIMBER STAND (1920) .....9,988,000,000 bd. ft.

PRINCIPAL STATES PRODUCING CUT—IN ORDER OF IMPORTANCE (1928):

Louisiana, Arkansas, Mississippi, Tennessee, Texas, South Carolina, Wisconsin, Florida, Georgia.

Range of Species

White Ash:

From Nova Scotia and New Brunswick to Florida and westward through southern Quebec and Ontario to eastern Minnesota, eastern Nebraska and Kansas, Oklahoma, southwestern Arkansas.

Green Ash:

From Maine (Penobscot County), Vermont (Lake Champlain), and southward in the Appalachian region to western Florida; westward to the Saskatchewan River, eastern ranges of the Rocky Mountains and extending into Utah (Wasatch Mountains) and eastern and northern Arizona (mountains), and through Texas (to Guadalupe River).

Black Ash:

Northern shores of Gulf of St. Lawrence and to Manitoba southward to Delaware, Virginia, West Virginia, southern Illinois and Indiana, Iowa.

Ash is a specialty wood and a favorite in the fabrication of many industrial products. The species are widely distributed in the forests, growing in association with other trees. The commercial range of ash is confined to the eastern part of the United States. Black ash and white ash are predominantly northern species, while green ash is a native of the southeastern forest region.

As a general rule, the ashes prefer rich soil, the trees frequently being found in rich river bottoms sometimes subject to overflow. Here ash is found in solid stands referred to as "ash thickets."

[1] Twenty-six species and varieties of the ashes are found in the United States, but it is estimated that 98 per cent of the entire cut is produced from three species: white, green, and black ash. The latter contributes more than the green or white species.

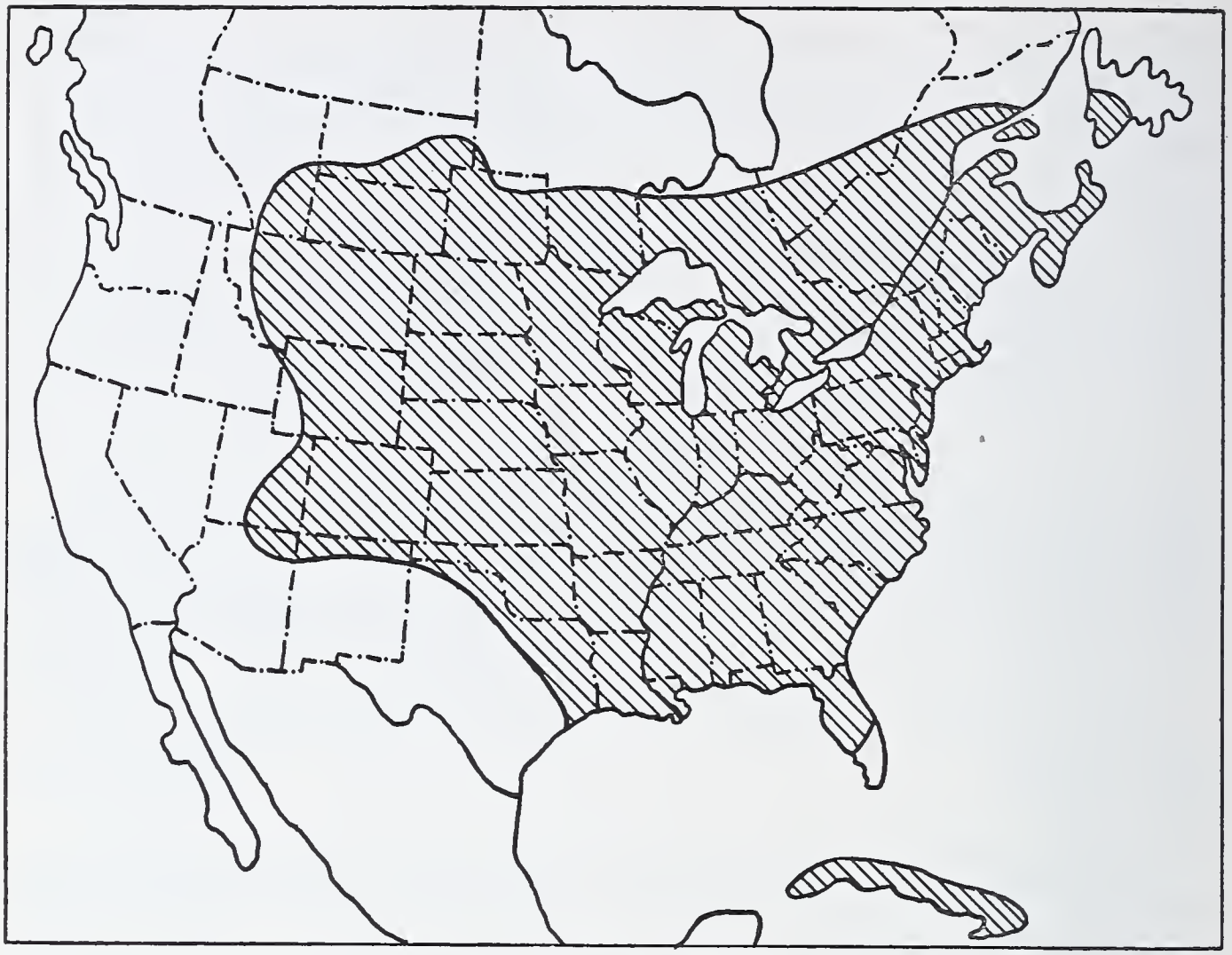


Illustration 18—General range of the ashes.

The tree grows quickly in early growth, slowing down as it approaches maturity. Ash has been cut quite heavily in the past and the result is that a generous amount of our present production is obtained from second-growth trees.

Usual Names

White ash
Green ash
Black (brown) ash

Also Called

White Ash:

White ash (Me., N. H., Vt., Mass., R. I., Conn., N. Y., N. J., Del., Pa., Md., Va., W. Va., N. C., S. C., Ga., Fla., Ala., Miss., La., Tex., Ky., Mo., Ill., Ind., Iowa, Kans., Nebr., Mich., Ohio, Ontario, Minn., N. Dak., Wis., trade)
Ash (N. C., Ark., Iowa, Wis., Ill., Mo., Minn.)
Northern white ash (trade)
American ash (Iowa)
Franc-frene (Quebec)

Cane ash (Ala., Miss., La.)
Ash (white), (trade)

Green Ash:

Green ash (Mass., R. I., Conn., N. Y., N. J., Pa., Del., N. C., S. C., Ala., Miss., La., Tex., Mo., Ill., Kan., Nebr., Mich., Minn., S. Dak., Ohio, Ontario, Iowa)
Blue ash (Ark., Iowa)
White ash (Kans., Nebr.)
Swamp ash (Fla., Ala., Tex.)
Ash (Ark., Iowa, Nebr.)
Water ash (Iowa)
Ash, white (trade)

Black Ash:

Black ash (Me., N. H., Vt., Mass., R. I., Conn., N. Y., N. J., Pa., Del., W. Va., Mo., Ohio, Ontario, Mich., Ill., Minn., trade)
Hoop ash (Vt., N. Y., Del., Ohio, Ill., Ind.)
Basket ash (Mass.)
Brown ash (N. H., Tenn., trade)
Swamp ash (Vt., R. I., N. Y.)
Water ash (W. Va., Tenn., Ind.)
Splinter ash (Conn.)
Ash, black or brown (trade)

Description

Ash belongs to the ring-porous group of hardwoods. In general the three species discussed closely resemble each other. Ash sapwood, because of its color, has been much demanded in the past by wood fabricators. Experiments undertaken by the Forest Products Laboratory, Madison, Wisconsin, show conclusively that the heartwood is just as strong and just as serviceable as the sapwood, when dried to equal moisture content and when of equal density.

The proportion of sapwood varies, the younger trees generally having the larger amount of sapwood. The sapwood is nearly white; the heartwood varies from light brown to brown with a slight tinge of red.

The wood of the ashes is known for its strength, stiffness, and shock-resisting ability. The ashes are hard, heavy and strong (see discussion under Caution—brashness). The wood produced from rapid growing white and green ash is rather coarse-grained, and does not develop an especially attractive figure. Old timber from slow growth trees produces a finer grained and often attractive figure. Frequently the wood is veneered, particularly the more important and valuable figured wood (curly ash).

Ash is usually straight-grained and is easily split. It shrinks but moderately in kiln-drying and is often dried directly from the green state. Tests indicate that this procedure reduces the tendency towards season checking. It can be easily bent, takes glue well, holds its shape well after fabrication, and takes finish, stains, etc. It also has excellent wearing properties.

Ash is not an especially durable wood in contact with the ground. White and green ash are considered more durable than black ash.

Uses

Ash is one of the leading commercial hardwoods of this country. Its relatively high value and the demand for its use in industrial fabricated products have precluded its use for construction purposes.

Lumbermen have in the past indicated a preference for white and black ash. Material from swelled butts of swamp grown green ash frequently exhibits brashness, but has been brought on the market to supply the general demand for ash stock.

Because of its strength, shock-resisting ability, and wearing qualities, ash has been a favorite for handle stock. Veneers consume large quantities, and it is used in panel work, furniture fabrication, container specialties, etc.

The following list suggests a few of the more important uses:

Vehicle and body parts
Handles
Cooperage
  butter tubs, paddles, etc.
  heading
Woodenware novelties
Furniture
  ice boxes, refrigerators, chairs, etc.
Boxes and crates
Planing mill products
  fixtures, panel stock, interior finish, etc.

Classifications

Ash lumber is graded according to Standard Inspection for Ash, Beech, Hard (or Sugar) Maple, Hackberry, Red Alder, and Sycamore, issued by the National Hardwood Lumber Association. (See general list of Associations for addresses.)

Attention is also called to grades for Rotary Cut Ash, Basswood, Beech, Birch, Elm, and Maple, issued by the same association.

Types and Sizes

The following grades and sizes represent ash lumber which is most commonly cut and consumed by manufacturers and fabricators. It is available either air-dried or kiln-dried, and is carried in stock by representative mills in producing regions.

TABLE 29

FAS	5/8	3/4	4/4	5/4	6/4	8/4	10/4	12/4	16/4
No. 1 Com. and Sel	1/2	4/4	5/4	6/4	8/4	10/4	12/4		
No. 1 Com. and Btr	4/4	5/4	6/4	8/4					
No. 2 Common	1/4	4/4	5/4	6/4	8/4				
No. 3 Common	4/4	5/4	8/4						
Log run	4/4	5/4	6/4	8/4	10/4	12/4	16/4		

Unit Packages

Ash, because of its value and wide range of price between the upper grades, is usually sold on actual board feet content basis. Lumber is frequently tallied on width and length tally in order to obtain average lengths and widths. Some fabricators specify minimum widths and lengths in purchasing strip stock, etc.

Shipping Weights

Shipping weights for ash lumber are listed below:

TABLE 30

ASH, WHITE

(*Fraxinus americana*)

Weight per Cubic Foot: Green, 48; Air-dry (12% MC), 41 Weights per Thousand Feet Surface Measure

(*Courtesy of Hardwood Manufacturers Institute*)

Thickness Inches (Actual)	*Green Weight (Note)*	*Per Cent of Moisture Content* 10%	12%	14%	16%	18%	20%
3/8	1500	1268	1282	1294	1307	1320	1333
13/32	1625	1374	1388	1401	1416	1430	1444
1/2	2000	1691	1709	1725	1742	1760	1778
17/32	2125	1797	1816	1833	1851	1870	1889
5/8	2500	2114	2136	2156	2178	2200	2222
11/16	2750	2325	2350	2372	2396	2420	2444
3/4	3000	2537	2563	2587	2614	2640	2666
13/16	3250	2748	2777	2803	2831	2860	2888
4/4	4000	3383	3417	3451	3486	3521	3556
17/16	4250	3594	3631	3665	3703	3740	3777
19/16	4750	4017	4058	4096	4138	4180	4222

NOTE: Green weights shown herein are predicated on the moisture content of the tree when felled.
To calculate weights at other moisture content, see Index—Moisture Content

TABLE 31

ASH, GREEN

(*Fraxinus pennsylvanica lanceolata*)

Weight per Cubic Foot: Green, 49; Air-dry (12% MC), 40 Weights per Thousand Feet Surface Measure

(*Courtesy of Hardwood Manufacturers Institute*)

Thickness Inches (Actual)	*Green Weight (Note)*	*Per Cent of Moisture Content* 10%	12%	14%	16%	18%	20%
3/8	1531	1237	1250	1262	1276	1288	1301
13/32	1659	1340	1355	1368	1382	1395	1409
1/2	2042	1650	1667	1683	1701	1717	1734
17/32	2169	1753	1771	1788	1807	1824	1843
5/8	2552	2062	2084	2104	2126	2146	2168
11/16	2807	2268	2292	2314	2339	2361	2385
3/4	3062	2474	2501	2525	2551	2575	2602
13/16	3318	2681	2709	2735	2764	2790	2818
4/4	4083	3300	3333	3366	3400	3434	3468
17/16	4333	3505	3543	3577	3614	3648	3686
19/16	4849	3918	3960	3998	4039	4077	4119

NOTE: Green weights shown herein are predicated on the moisture content of the tree when felled.
To calculate weights at other moisture content see Index—Moisture Content

TABLE 32

ASH, BLACK

(*Fraxinus nigra*)

Weight per Cubic Foot: Green, 52; Air-dry (12% MC), 34 Weights per Thousand Feet Surface Measure

(*Courtesy of Hardwood Manufacturers Institute*)

Thickness Inches (Actual)	*Green Weight (Note)*	*Per Cent of Moisture Content*					
		10%	12%	14%	16%	18%	20%
3/8	1625	1052	1062	1073	1084	1094	1105
13/32	1760	1140	1151	1162	1174	1186	1197
1/2	2166	1403	1416	1430	1445	1459	1474
17/32	2302	1491	1505	1520	1535	1550	1566
5/8	2708	1754	1770	1788	1806	1824	1842
11/16	2979	1929	1947	1967	1987	2006	2026
3/4	3250	2105	2124	2146	2167	2189	2210
13/16	3520	2280	2301	2324	2348	2371	2395
4/4	4333	2805	2833	2861	2890	2919	2948
17/16	4604	2982	3009	3040	3070	3101	3131
19/16	5145	3332	3363	3218	3431	3466	3500

NOTE: Green weights shown herein are predicated on the moisture content of the tree when felled.

To calculate weights at other moisture content see Index—Moisture Content

Ordering

Clearly specify in order that "no brash stock will be accepted," provided that the purpose for which the lumber is to be used would preclude its use.

Ash is one of our higher priced woods, and a careful analysis of grades will indicate the adaptability of various grades for specific purposes. Often it has been found that lumber of Selects, or No. 1 Common grade, can be used just as advantageously as Firsts and Seconds. This entirely depends upon fabrication, clear face, cutting sizes, etc.

Caution

One of the defects of ash stock is its tendency to exhibit brashness, which is a lack of strength in the wood, or brittleness. There is no accurate method of detecting it by visual inspection but brash stock generally can be distinguished by pitted ends when saw cuts are made and by the manner in which saw cuts break out under a knife blade. It can be determined, however, by means of a density test. Any suspicious lightness of the wood might indicate a brash condition and should be carefully watched.

For additional data refer to discussion under "Caution—Brashness."

Special Service Requirements

Ash offers remarkable stiffness, shock-resisting ability, and strength. It is a logical species for bending purposes, and numerous specialty uses where the above properties are required. Other points in its favor are its ease of drying, its ability to stay in place after fabrication, its wearing qualities, and beauty of figure and grain.

Specifications

The following publications may be consulted for information regarding specifications for ash:

Standards and Specifications in the Wood-Using Industries — Bureau of Standards.
National Directory of Commodity Specifications — Bureau of Standards.

(See general Bibliography for publishers' addresses.)

Engineering Data

(See Table 2.)

Improvements

(See discussion on this subject.)

Associations

The following associations will be glad to give information regarding lumber and other stock cut from ash:

Appalachian Hardwood Club.
National Hardwood Lumber Association (Grading rules).
Hardwood Manufacturers Institute (Production figures and prices).
National Lumber Manufacturers Association (General information and data).
Northern Hemlock and Hardwood Manufacturers Association (Information on uses; list of members cutting this species).

(See general list of Associations for addresses.)

Publications

The following publications frequently carry trade items regarding ash, prices, and other data:

American Lumberman
Gulf Coast Lumberman
Hardwood Buyers Guide
Hardwood Record
Lumber Trade Journal
Lumbermen's Clearing House Buyers' Guide
Memphis Lumberman and Southern Woodworker
Mississippi Valley Lumberman
National Lumberman
New York Lumber Trade Journal, The
Pennsylvania Lumberman
Southern Lumberman
Southern Lumber Journal
Veneers
Wood Workers Clearing House Journal
Wood Working Industries

(See general list of Periodicals for publishers' addresses.)

Bibliography

The following books and articles may prove helpful to readers desiring further information:

Utilization of Ash—W. D. Sterrett.
The Relation of Growth Factors to Wood Quality—White Ash—Benson H. Paul.
Lumber and Its Uses—R. S. Kellogg.
American Forest Trees—Henry H. Gibson.

(See general Bibliography for publishers' addresses.)

Abbreviations and Terminology

(See general list of Abbreviations and Glossary.)

BASSWOOD

(A Hardwood)

Tilia glabra

Annual Production (1928) ..... 140,094,000 bd. ft.
Average Value of Lumber at Mill per M.B.F. $39.72
Timber Stand (1922) ..... 12,000,000 bd. ft.

Principal States Producing Cut—in Order of Importance:

Wisconsin, Michigan, West Virginia, Tennessee, North Carolina, New York, Virginia, Indiana, Vermont, Kentucky, Pennsylvania.

Range of Species

New Brunswick to Lake Superior, to Lake Winnipeg and Assiniboine River, south to Pennsylvania, Ohio, through Michigan, Indiana, Illinois, and eastern Nebraska, to Missouri.

Basswood is one of the important commercial hardwood trees of the United States. Its lumber is cut from several species, but mainly from the species *Tilia glabra*. All of the

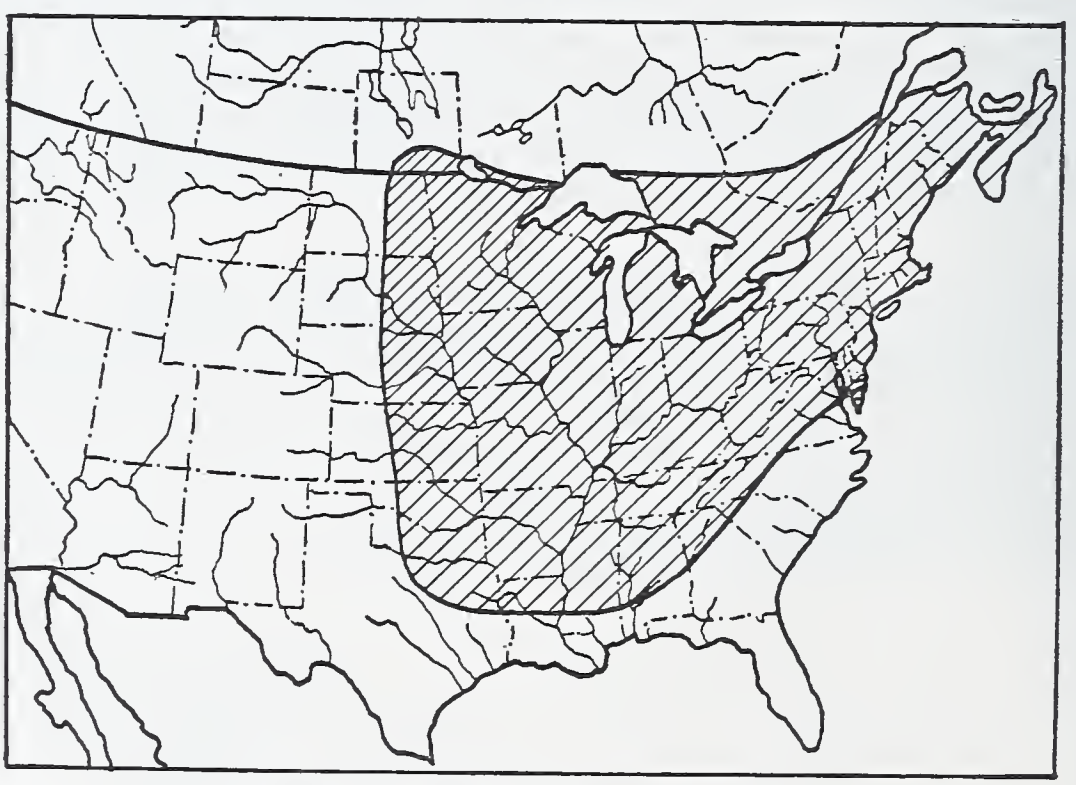


Illustration 19—General range of basswood.

species are quite similar, and for practical purposes no differentiation is made in the trade. The species *Tilia glabra* grows throughout nearly all of the eastern part of the United States.

Usual Name

The most common name of the species is basswood (*Tilia glabra*).

Also Called

Basswood (Me., N. H., Vt., R. I., Mass., Conn., N. Y., N. J., Del., Ill., Ind., Mich., Ohio, Nebr., trade)
American Linden (Me., N. H., R. I., N. Y., Pa., Del., Ohio, Ill., Nebr., and hort.)
Linn (Pa., Ill., Ind., Ohio, Mo., Nebr.)
Linden (Vt., R. I., Pa., Nebr.)
Limetree (R. I., Ill.)
Whitewood (Vt., Ontario)
Beetree (Vt.)
Wickup (Mass.)
Yellow Basswood (Ind.)
Lein (Ind.)
Bass tree
White linn
Black limetree
Spoonwood
Whistlewood

Description

Basswood is valued greatly because of its light weight, white color, and excellent working qualities. The wood varies, however, in weight and softness according to the various species. The heartwood is creamy white, often accompanied by characteristic brown streaks. The sapwood is generally wide and not clearly defined from the heartwood.

The wood is of the ring-porous variety and very porous in structure. These pores are small and not visible to the naked eye.

The wood is soft, works well, holds its shape well, and is comparatively tough for its specific gravity. It also has excellent nail and screw holding ability. It veneers and glues well.

Uses

Basswood at present is little used for building purposes. Formerly, however, large quantities were used in the manufacture of ceiling. Its most important field is now for fabricated products, such as boxes and crates, woodenware, trunks, toys, washboards, etc. Because of its close resemblance to other woods — yellow poplar, cottonwood, and tupelo — it often is substituted for them.

Basswood is well adapted for certain special uses for which other woods do not serve as well and, because of the comparatively small supply now available, it is greatly in demand for these purposes. It is valued highly for products made of wood in the natural state, particularly where a clean appearance and light weight are essential. In construction basswood is used particularly in the manufacture of interior trim, where it goes into hidden parts. It is valued here because it is easy to work and takes nails and screws well. It also serves for the cores of high-grade panels covered with veneer, for drawer bottoms, etc. The great bulk of it, however, goes into boxes and crates, specialized products, woodenware novelties, picture frames, moldings, etc.

Following is a list of the most important uses for basswood:

Molding (picture, etc.)	Woodenware
Specialized boxes (egg crates and cases)	Ironing boards
Boxes and crates	Washboards
Thermometer backing	Washing machine tubs
Car stock	Organ valves
Veneers	Furniture
Apiarist supplies	Matches
Trunk panels	Toys

Classifications

Basswood lumber is graded to Standard National Hardwood Rules, with exceptions as indicated for rules covering basswood, soft elm, soft maple, and buckeye, published by the National Hardwood Lumber Association.

(See general list of Associations for addresses.)

Types and Sizes

The following grades and sizes represent lumber which is most commonly cut and consumed by manufacturers and fabricators. It is available either air-dried or kiln-dried, and is carried in stock by representative mills in producing regions:

TABLE 33

FAS	4/4	5/4	6/4	8/4	
No. 1 Com. and Sel	1/2	4/4	5/4	6/4	8/4
No. 3 Common	4/4				
Clear face strips	4/4				

Unit Packages

Sold on log run, mill run, or *Standard Grade* basis.

Lumber is measured on board feet basis, and tallied by (*a*) actual board feet content tally; (*b*) export tally ("width and length tally" or tally on 12-ft. basis).

Weights

TABLE 34

BASSWOOD

(*Tilia glabra*)

Weight per Cubic Foot: Green 41; Air-dry (12% MC), 26 — Weights per Thousand Feet Surface Measure

(*Courtesy of Hardwood Manufacturers Institute*)

Thickness Inches (Actual)	*Green Weight (Note)*	*Per Cent of Moisture Content*					
		10%	12%	14%	16%	18%	20%
3/8	1282	804	812	821	829	838	846
13/32	1388	871	880	889	898	907	917
1/2	1709	1072	1083	1094	1106	1117	1128
17/32	1816	1139	1151	1163	1175	1187	1199
5/8	2136	1340	1354	1368	1382	1396	1410
11/16	2350	1474	1489	1505	1520	1536	1551
3/4	2563	1608	1625	1642	1658	1675	1692
13/16	2777	1742	1760	1778	1797	1815	1833
4/4	3417	2145	2167	2189	2211	2233	2255
17/16	3631	2278	2302	2326	2349	2373	2397
19/16	4058	2546	2573	2599	2626	2652	2679

NOTE: Green weights shown herein are predicated on the moisture content of the tree when felled.

To calculate weights at other moisture content see Index—Moisture Content

Ordering

(Follow general instructions for "Ordering Hardwoods.")

Caution

Properties of basswood vary. These variations to a great extent are based upon the species of the tree, locality where it is cut, etc. In ordering basswood keep in mind the need of securing stock from producing mills where a *known* quality and character of wood exist.

(For further information consult general discussion under "Caution.")

Special Service Requirements

Basswood is admirably suited for use where the following requirements must be met:

Lightness
Softness
Ease in working
White color when left unfinished

Specifications

The following publications may be consulted for information regarding specifications for basswood:

Standards and Specifications in the Wood-Using Industries—Bureau of Standards.
National Directory of Commodity Specifications—Bureau of Standards.

(See general Bibliography for publishers' addresses.)

Engineering Data

(See Table 2.)

Improvements

(See general discussion under this heading.)

Associations

The following associations will be glad to furnish further data:

National Hardwood Lumber Association (Rules).
Northern Hemlock and Hardwood Manufacturers Association (General information).
Appalachian Hardwood Club (General information).
Hardwood Manufacturers Institute (Production, prices, etc.).

(See general list of Associations for addresses.)

Publications

The following publications frequently carry trade items regarding basswood:

American Builder
American Lumberman
American Woodworking Review
Gulf Coast Lumberman
Hardwood Record
Industrial Woodworking
Lumber Co-operator
Lumber Trade Journal
Lumber Worker
Lumbermen's Clearing House Buyers' Guide
Memphis Lumberman and Southern Woodworker
Millwork
Mississippi Valley Lumberman
National Lumberman
National Retail Lumber Dealer
New York Lumber Trade Journal, The
Pennsylvania Lumberman
Retail Lumberman
Retail Lumber Trade News
Southern Lumberman
Southern Lumber Journal
Veneers
Wood Workers Clearing House Journal
Wood Construction
Wood Preserving News
Wood-Worker, The
Wood Working Industries

(See general list of Periodicals for publishers' addresses.)

Bibliography

The following books and articles may prove helpful to readers desiring further information:

Handbook on Appalachian Hardwoods—David C. White.
Utilization of Basswood—Warren D. Brush.
American Forest Trees—Henry H. Gibson.
Lumber and Its Uses—R. S. Kellogg.

(See general Bibliography for publishers' addresses.)

Abbreviations and Terminology

Basswood generally is not abbreviated in the trade.

(See general list of Abbreviations and Glossary.)

BEECH[1]

(A Hardwood)

Fagus grandifolia

ANNUAL PRODUCTION (1928).....146,207,000 bd. ft.
AVERAGE VALUE OF LUMBER CUT AT MILL PER M.B.F. (1928).....$28.63
TIMBER STAND (1920).....20 to 25,000,000,000 bd. ft.

PRINCIPAL STATES PRODUCING CUT — IN ORDER OF IMPORTANCE (1928):

Pennsylvania, New York, Michigan, Indiana, West Virginia, Ohio, Tennessee, Kentucky, Vermont, Louisiana.

Range of Species

New Brunswick to Lake Huron, Minnesota, and northern and east central Wisconsin; south to western Florida, Missouri, and eastern Texas.

The commercial beech in the United States is restricted to one species, which has a wide range over the eastern part of this country. In the trade it is commonly spoken of as red beech and white beech, which indicate, respectively, the heartwood and sapwood of the tree. The contrast between the two is marked, the heartwood showing a slight reddish tinge and the sapwood being a decided white. In the forest, beech occasionally occurs in pure and solid stands, but it is also widely scattered among its close associates, birch and maple. It was formerly very abundant, but much of it has been eliminated in the clearing up of timberlands for farming purposes, where it was considered more or less as a pest, and was cut and burned in order to get rid of it. Beech is another of the woods which was not utilized until comparatively recent years. The American beech is closely associated with the European variety, but it is not considered to be of as good quality and workability.

Usual Name

Beech

Also Called

Beech (Me., N. H., Vt., Mass., R. I., Conn., N. Y., N. J., Pa., Del., Va., Tenn.,W.Va., N. C., S. C., Ga., Ala., Fla., Miss., La., Tex. Ark., Ky., Mo., Ohio, Ill., Ind., Mich., Nebr., Minn., Ontario, trade)
Red Beech (Me., Vt., W. Va., Ky., Ohio, N. Y., Ontario)
White Beech (Me., N. Y., Ohio, Mich., W. Va.)
Ridge Beech (Ark.)
Winter Beech (W. Va.)
American Beech (lit. and hort.)
Stone Beech

[1] Only this one species of beech is native to the United States.

Illustration 20—General range of beech.

Description

The wood of beech is slightly harder than sycamore, and slightly softer than hard maple. It is ring-porous, close-textured, generally strong and hard. It has good shock-resisting and abrasive qualities. It shrinks greatly in drying and is considered difficult to season, having a decided tendency to check and warp. Newly developed seasoning methods and kiln-drying schedules are overcoming this difficulty, however.

The heartwood varies in color from a reddish brown to almost white, with a reddish cast similar to the sapwood.

It is well adapted to turning and fabrication and produces a smooth, hard finish. When thoroughly dry it holds its shape well. It has good glue and nail holding qualities. It is not lasting when exposed to conditions favoring decay.

Uses

Approximately 25 per cent of beech lumber goes into planing mill products, particularly flooring. The following is a list of some of the important uses for beech:

Planing mill products	Handles
Furniture and furniture parts	Novelties, toys, etc.
Woodenware (bowls, etc.)	Vehicle body parts
Containers	Cross ties and rough construction
Boxes and crates	(crossing plant, rough bridging, etc.)

Beech was formerly used to a large extent in wood distillation.

Classifications

Beech lumber is graded according to Standard Grading Rules for Ash, *Beech*, Birch, Hard (or Sugar) Maple, Hackberry, Red Alder and Sycamore, issued by the National Hardwood Lumber Association.

Beech flooring is graded according to Rules for Grading Maple, Beech, and Birch Flooring, issued by Maple Flooring Manufacturers Association.

(See general list of Associations for addresses.)

Types and Sizes

The following grades and sizes represent lumber which is most commonly cut and consumed by manufacturers and fabricators. It is available either air-dried or kiln-dried and is carried in stock by representative mills in producing regions:

TABLE 35

FAS	4/4	5/4	6/4	8/4
No. 1 Com. and Selects	4/4	5/4	6/4	8/4
No. 2 Common	4/4	5/4	6/4	
No. 3 Common	4/4			
Log run	5/8	4/4	6/4	8/4

Unit Packages

Beech lumber is sold on log run, mill run, or standard grade basis. The lumber is measured on board foot basis and is tallied by actual board feet content tally, or export tally.

Shipping Weights

The weights of beech lumber are as follows:

TABLE 36

BEECH

(*Fagus grandifolia*)

Weight Per Cubic Foot: Green 55; Air-dry (12% MC), 44 — Weights Per Thousand Feet Surface Measure

Thickness Inches (Actual)	*Green Weight (Note)*	*Per Cent of Moisture Content*					
		10%	12%	14%	16%	18%	20%
3/8	1718	1361	1375	1390	1403	1417	1432
13/32	1862	1474	1490	1505	1520	1535	1551
1/2	2291	1814	1834	1853	1870	1890	1909
17/32	2434	1928	1948	1969	1987	2008	2028
5/8	2864	2268	2292	2316	2338	2362	2386
11/16	3150	2495	2521	2548	2572	2598	2625
3/4	3437	2722	2750	2779	2806	2834	2863
13/16	3723	2948	2980	3011	3039	3071	3102
4/4	4583	3630	3667	3704	3741	3778	3816
17/16	4869	3856	3896	3937	3975	4015	4056
19/16	5442	4309	4355	4400	4442	4488	4533

NOTE: Green weights shown herein are predicated on the moisture content of the tree when felled.

To calculate weights at other moisture content, see Index—Moisture Content.

Ordering. (See general discussion on this subject.)

Caution. (See general discussion on this subject.)

Special Service Requirements

Beech is one of the cheaper hardwood species. It offers good utilization where (1) economical hardwood is required; (2) moderate strength and hardness are needed; (3) where good shock-resisting ability is required; and (4) for turned articles, etc.

Specifications

The following publications may be consulted for information regarding specifications for beech:

Standards and Specifications in the Wood-Using Industries—Bureau of Standards.
National Directory of Commodity Specifications—Bureau of Standards.

(See general Bibliography for publishers' addresses.)

Engineering Data. (See Table 2.)

Improvements

Recent study and research have developed efficient seasoning and drying schedules which have overcome the difficulties formerly encountered in the seasoning of beech lumber.

Flooring manufacturers have perfected the machining and kiln-drying of beech so that it now has a prominent place in the flooring production in this country.

Associations

The following associations will be glad to give information regarding lumber and other stock cut from beech:

National Hardwood Lumber Association (Grading rules and inspection service).
Hardwood Manufacturers Institute (Production figures and prices).
National Lumber Manufacturers Association (Information on uses).
Northern Hemlock and Hardwood Manufacturers Association (Information on uses; list of members cutting this species).
Maple Flooring Manufacturers Association (Grading rules for beech flooring).
Appalachian Hardwood Club (General information).

(See general list of Associations for addresses.)

Publications

The following publications frequently carry trade items regarding beech, prices, and other data:

American Lumberman
Gulf Coast Lumberman
Hardwood Buyers Guide
Hardwood Record
Industrial Woodworking
Lumber Trade Journal
Lumber Worker
Lumbermen's Clearing House Buyers' Guide
Memphis Lumberman and Southern Woodworker
Millwork
Mississippi Valley Lumberman
National Lumberman
National Retail Lumber Dealer
New York Lumber Trade Journal, The
Pennsylvania Lumberman
Retail Lumberman
Retail Lumber Trade News
Southern Lumberman
Southern Lumber Journal
Wood Preserving News
Wood-Worker, The
Wood-Working Industries

(See general list of Periodicals for publishers' addresses.)

Bibliography

The following books and articles may prove helpful to readers desiring further information:

The Use of Commercial Woods in the United States—Beech, Birches, and Maples—Hu Maxwell.
Beech—For Serv. Leaflet, American Wood Series.
Lumber and Its Uses—R. S. Kellogg.
American Forest Trees—Henry H. Gibson.

(See general Bibliography for publishers' addresses.)

Abbreviations and Terminology

(See general list of Abbreviations and Glossary.)

THE BIRCHES[1]

(Hardwoods)

YELLOW BIRCH
Betula lutea

SWEET BIRCH
Betula lenta

PAPER BIRCH
Betula papyrifera

ANNUAL PRODUCTION (1928).....337,550,000 bd. ft.
AVERAGE VALUE OF LUMBER CUT AT MILL PER M.B.F. (1928).....$40.30
TIMBER STAND (1925).....19,000,000,000 bd. ft.

PRINCIPAL STATES PRODUCING CUT — IN ORDER OF IMPORTANCE (1928):

Wisconsin, Michigan, New York, Maine, Vermont, New Hampshire, West Virginia.

Range of Species

Yellow Birch:

From Newfoundland and along the northern shores of St. Lawrence Gulf to Abitibi Lake and Rainy River; southward through northern Minnesota to central Iowa, and through the northern states to eastern Tennessee, western North Carolina, northern Georgia, and Delaware.

Sweet Birch:

Southern Maine to northwestern Vermont, Michigan, Ohio, Kentucky, and Delaware, and in the eastern mountains to Georgia and Alabama.

Paper Birch:

From Labrador to Hudson Bay (southern shores); southward to New York (Long Island) and northern Pennsylvania, central Michigan, northern Indiana, northern Wisconsin, North Dakota, South Dakota (Black Hills), eastern Nebraska, and Wyoming.

The three species mentioned above are the most important of the birch family. *Yellow birch* supplies probably 75 per cent of the total cut; *sweet birch*, 15 per cent; and *paper birch*, around 10 per cent.

In the trade, yellow birch and sweet birch are sold as "birch," and no attempt is made to separate the species.

The birches grow in association with beech and maple. They attain their best and most important development near the Canadian border, particularly in the Lake States region and the northeast. The bulk of birch timber is now found in Maine, Wisconsin, New York, Michigan, Minnesota, Vermont, and New Hampshire.

[1] Twenty varieties or species make up the birch family in the United States. Those species indicated above supply the bulk of commercial birch lumber.

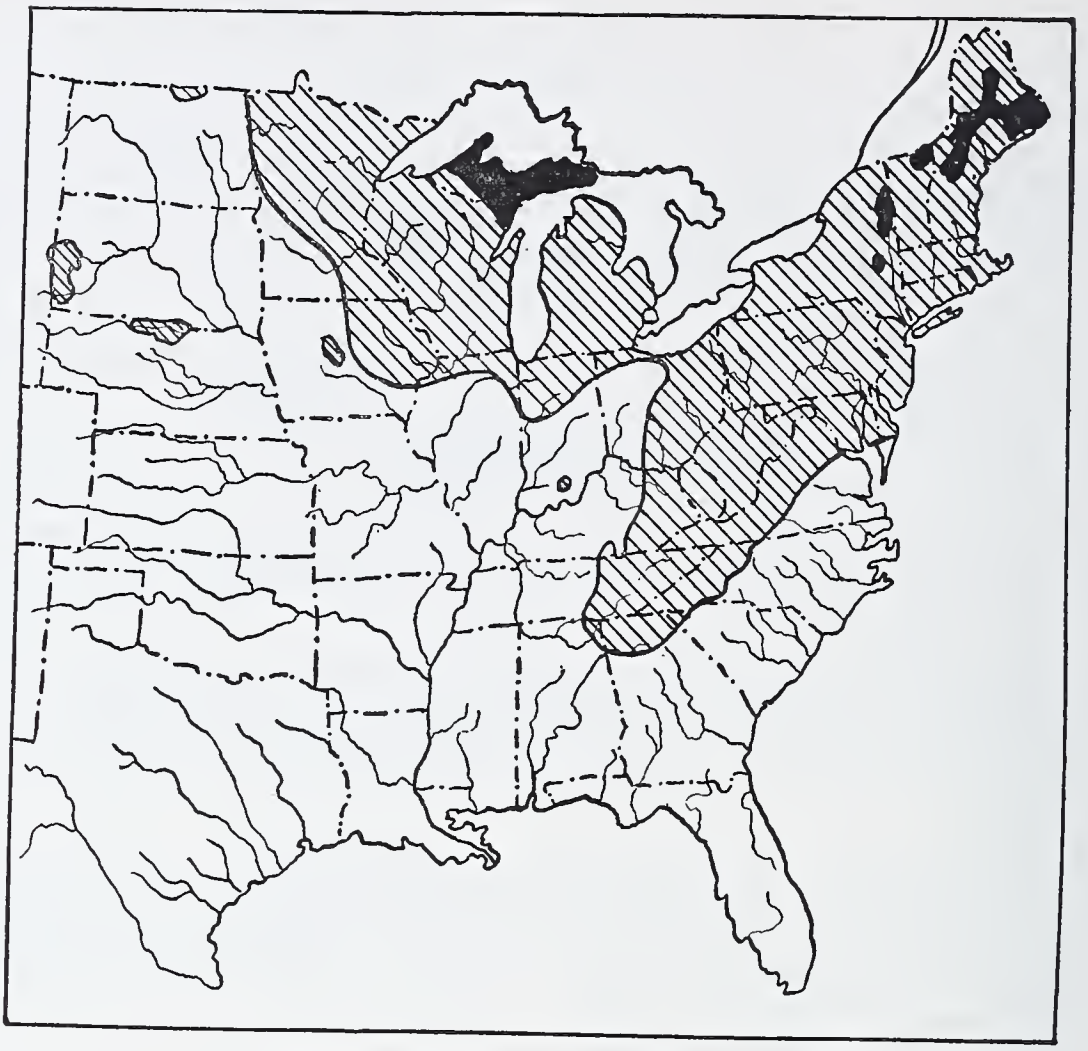


Illustration 21—General range of the birches.

Usual Names

Yellow birch (red birch)
Sweet birch
Paper birch

Also Called

Yellow Birch:

Yellow birch (Me., N. H., Vt., Mass., Conn., R. I., N. Y., N. J., Pa., N. C., S. C., Ill., Mich., Minn., Ontario)
Gray birch (Vt., R. I., Pa., Mich., Minn.)
Silver birch (N. H.)
Merisier (Quebec)
Merisier rouge (Quebec)
White birch (N. C.)
Birch (N. C., trade)
Witch hazel (Newfoundland, trade)

Sweet Birch:

Sweet birch (Me., N. H., Vt., Mass., R. I., N. J., Pa., Del., S. C.)
Birch (trade, N. C.)

Black birch (N. H., Vt., Mass., R. I., Conn., N. Y., N. J., Pa., Va., W. Va., Ga., Ohio)
Cherry birch (N. H., R. I., N. Y., Pa., Ky., Del., Va., N. C., S. C., Ga.)
River birch
Mahogany birch (N. C., S. C.)
Mountain mahogany (N. C., S. C.)
Mahogany (N. C.)
Spice birch

Paper Birch:

Paper birch (N. H., Vt., Mass., R. I., Conn., N. Y., Wis., Minn., Ontario)
Canoe birch (Me., Vt., N. H., R. I., Mass., N. Y., Pa., Wis., Mich., Minn., Ontario, hort.)
White birch (Me., N. H., Vt., R. I., N. Y., N. J., Wis., Mich., Nebr., Ontario)
Silver birch (Minn.)
Large white birch (Vt.)
Boileau (Quebec)
Birch (trade)

Description

The wood of the various birches is similar in general structure, but varies in color and mechanical properties. The heartwood of the yellow birch is light reddish-brown and is spoken of in the trade as *red* birch. The sapwood is practically white. Sweet birch heartwood is dark brown with a tinge of red; sapwood varies from a light brown to a dirty white color. In paper birch the heartwood is brown, generally quite light in color. The sapwood is nearly white.

Birch wood is noted for its versatility. It is hard, heavy, stiff, and strong, and has good shock-resisting qualities. This particularly applies to yellow birch and sweet birch. Paper birch and the other birches are not quite so strong, mechanically.

The wood of the birches is easily veneered and takes a good polish. It glues easily, is easily kiln-dried, and shrinks only moderately.

Paper birch turns well and is much desired for turned products.

The wood of the birches, in general, is not especially durable. Often the wood shows an attractive figure (curly) and this is much desired for certain fabricated products. Birch wood is often finished to imitate mahogany. This is done through staining and polishing.

Uses

Yellow and sweet birch are used extensively for planing mill products, particularly flooring, interior trim, panel stock, etc. They are also used to a large extent for furniture fabrication. The following is a list of some of the important uses for yellow birch and sweet birch:

Flooring
Furniture fabrication
Interior trim and woodwork
Veneers and panels
Vehicle and automotive body parts
Office fixtures and furniture
Dowel pins
Woodenware
Boxes and crates
Novelties

Large quantities of paper birch are used for turned articles, such as spools, bobbins, door knobs, button molds, etc.

The wood of the birches in general has long been a favorite for wood distillation purposes.

Classifications

No distinction is made in grading rules for the various species of birch. It is graded according to Standard Inspection for Ash, Beech, Birch, Hard (or Sugar) Maple, Hackberry, Red Alder, and Sycamore, issued by the National Hardwood Lumber Association. Attention is also called to Grading Rules for *Red Birch* and Rotary Cut Ash, Basswood, Beech, *Birch*, Elm, and Maple, of the same association. Birch flooring rules are found in Grading Rules for Maple, Beech, and *Birch* Flooring, issued by the Maple Flooring Manufacturers Association.

(See general list of Associations for addresses.)

Types and Sizes

The following grades and sizes represent birch lumber which is most commonly cut and consumed by manufacturers and fabricators. It is available either air-dried or kiln-dried, and is carried in stock by representative mills in producing regions:

TABLE 37

FAS....4/4	5/4	6/4	8/4	10/4	12/4	16/4
No. 1 Com. and Sel....4/4	5/4	6/4	8/4			
No. 2 Common....4/4	5/4					
No. 3 Common....4/4						

Unit Packages

Birch lumber is usually sold on standard grade basis. Actual board feet content tally is most frequently used, except in cases of export or special tally, where length and width tally is used.

Shipping Weights

Shipping weights for birch lumber are as follows:

TABLE 38

BIRCH, YELLOW
(*Betula lutea*)

Weight per Cubic Foot: Green, 58; Air-dry (12% MC), 43 — Weights per Thousand Feet Surface Measure

(*Courtesy of Hardwood Manufacturers Institute*)

Thickness Inches (Actual)	*Green Weight (Note)*	*Per Cent of Moisture Content*					
		10%	12%	14%	16%	18%	20%
3/8	1812	1331	1344	1357	1370	1385	1398
13/32	1963	1440	1456	1470	1485	1500	1515
1/2	2416	1773	1792	1810	1827	1846	1864
17/32	2567	1884	1904	1923	1941	1962	1981
5/8	3020	2216	2240	2262	2284	2308	2330
11/16	3322	2438	2464	2488	2512	2539	2563
3/4	3624	2659	2688	2714	2741	2770	2796
13/16	3926	2881	2912	2941	2969	3000	3029
4/4	4833	3547	3583	3619	3655	3692	3729
17/16	5134	3767	3808	3845	3883	3924	3961
19/16	5738	4210	4256	4298	4340	4385	4427

NOTE: Green weights shown herein are predicated on the moisture content of the tree when felled.
To calculate weights at other moisture content see Index—Moisture Content.

Ordering

(Follow general instructions under this heading.)

Caution

Note particularly the sapwood is not a defect in Standard Grades of birch.
Yellow dote is often common in old lumber. Watch for it carefully.

Special Service Requirements

Birch is often used as a substitute for and in combination with mahogany. The grain is such that after finishing it closely resembles that species. It is also used where strength and resistance are required. It is noted for its wearing ability.

Turned articles made of birch are easily machined, finish smoothly, and are ideal for finishing.

Specifications

The following publications may be consulted for information regarding specifications for birch:

Standards and Specifications in the Wood-Using Industries—Bureau of Standards.
National Directory of Commodity Specifications—Bureau of Standards.

(See General Bibliography for publishers' addresses.)

Engineering Data

(See Table 2.)

Improvements

(See general discussion on this subject.)

Associations

The following associations will be glad to give information regarding lumber and other stock cut from the birches:

Appalachian Hardwood Club.
National Hardwood Lumber Association (Grading rules).
National Lumber Manufacturers Association (General information).
Hardwood Manufacturers Institute (Production figures and prices).
Northern Hemlock and Hardwood Association (Production figures and costs).
Rotary Birch Club (Production figures and costs).

(See general list of Associations for addresses.)

Publications

The following publications frequently carry trade items regarding birch, prices, etc.:

American Lumberman
American Woodworking Review
Hardwood Buyers Guide
Hardwood Record
Industrial Woodworking
Lumber Trade Journal
Lumbermen's Clearing House Buyers' Guide
Memphis Lumberman and Southern Woodworker
Millwork
Mississippi Valley Lumberman
National Lumberman
National Retail Lumber Dealer
New York Lumber Trade Journal, The
Pennsylvania Lumberman
Retail Lumberman
Retail Lumber Trade News
Southern Lumberman
Southern Lumber Journal
Veneers
Wood Workers Clearing House Journal
Wood Construction
Wood Preserving News
Wood-Worker, The
Wood Working Industries

(See general list of Periodicals for publishers' addresses.)

Bibliography

The following books and articles may prove helpful to readers desiring further information:

Use of Commercial Woods of the United States (Beech, Birches, and Maples)—Hu Maxwell.
"Birch"—Forest Service Leaflet, *American Wood Series.*
Identification of Furniture Woods—Arthur Koehler.
Lumber and Its Uses—R. S. Kellogg.
American Forest Trees—Henry H. Gibson.
Handbook of the Trees of the Northern United States and Canada, East of the Rocky Mountains—R. B. Hough.

(See general Bibliography for publishers' addresses.)

Abbreviations and Terminology

R'd birch—red (or yellow) birch
S't birch—sweet birch

(See general list of Abbreviations and Glossary.)

YELLOW BUCKEYE[1]

(A. Hardwood)

Æsculus octandra

ANNUAL PRODUCTION (1928) ..... 1,924,000 bd. ft.
AVERAGE VALUE OF LUMBER CUT AT MILL PER M.B.F. (1928) $30.89
TIMBER STAND ..... (No figures)

PRINCIPAL STATES PRODUCING CUT—IN ORDER OF IMPORTANCE (1928):

Tennessee, North Carolina, Indiana.

Range of Species:

From Pennsylvania (Allegheny County) and along the Allegheny Mountains to eastern Tennessee, Georgia (Augusta), and northern Alabama (mountains); westward to Ohio, southern Indiana, and Illinois.

Buckeye belongs to the horse-chestnut species and has a rather extended range over the eastern United States. It grows scattered and intermingled with other hardwoods in the forest, and frequently occurs in stands with oaks, yellow poplar, maple, beech, birch, etc.

Buckeye has never been considered as an important commercial tree, due partially to the predominance of other hardwoods possessing more favorable qualities. It is generally cut along with other trees surrounding it. The wood closely resembles sap poplar and basswood, and is sometimes sold in shipments of yellow poplar "saps" and basswood lumber. Little distinction is made between the various species and variations of buckeye by the cutting mills, since their properties are so similar.

The bulk of buckeye lumber is produced in Tennessee and North Carolina.

Usual Names

Buckeye
Yellow buckeye
Ohio buckeye

Also Called

Buckeye (N. C., S. C., Ala., Ky., trade)
Sweet buckeye (W. Va., Ind.)
Yellow buckeye (N. C., S. C., Ala.)
Large buckeye (Tenn.)
Big buckeye (Tenn.)
Ohio buckeye (Pa., cult.)

[1] There are approximately 24 species and varieties of buckeye found in the United States; of these, the following are the more important:

Yellow buckeye,	*Æsculus octandra*
Ohio buckeye,	*Æsculus glabra*
California buckeye,	*Æsculus californica*
Southern (scarlet) buckeye,	*Æsculus austrina*
Scarlet buckeye,	*Æsculus discolor mollis*

The bulk of commercial buckeye lumber is cut from Æsculus octandra.

Description

The wood is light, soft, straight-grained, and is difficult to split; it is weak, and not very stiff. It is softer than "sap" poplar, but closely resembles it in color. It even more closely resembles basswood in all its general properties.

Buckeye belongs to the diffuse-porous hardwood class. It has little or no figure. The heartwood is not clearly distinguishable from the sapwood. Color ranges from creamy white to a yellowish tinge. Very often stains of a reddish-brown color—termed "mineral

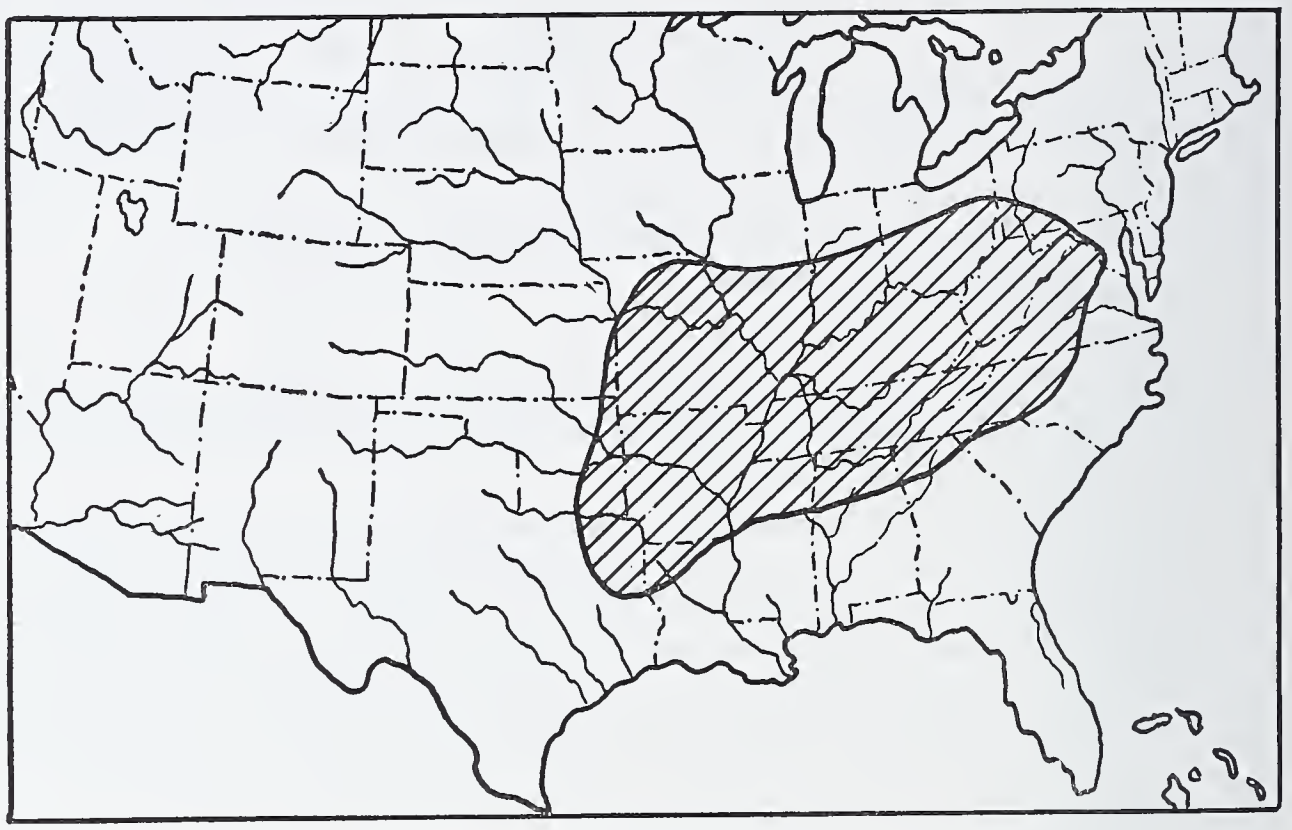


Illustration 22—General range of yellow buckeye.

streaks"—occur in the wood. Blue stain is common during the seasoning process. Buckeye is tasteless and odorless. Ohio buckeye, however, has a characteristic odor, but only a small amount of this species enters the market, due to its limited range and small size.

Uses

Buckeye is a typical substitute wood. It is one of the lower priced hardwoods, and in localities where it attains its maximum growth and abundance it is used for a variety of purposes, and is considered an important species. It can be used for practically all of the purposes for which basswood and "sap" yellow poplar are used. The following is a list of its important uses:

Boxes and crates
Excelsior
Fixtures and moldings, frames
Specialty boxes (spice, tea, candy)
Containers
Slack cooperage
Woodenware (bowls, dishes, etc.)
Artificial limbs
Pulpwood

Classifications

Buckeye is graded according to Standard Inspection for Basswood, Soft Elm, Soft Maple and *Buckeye*, issued by the National Hardwood Lumber Association.

(See general list of Associations for addresses.)

Types and Sizes

The following grades and sizes represent lumber which is mostly commonly cut and consumed by manufacturers and fabricators. It is available either air-dried or kiln-dried, and carried in stock by representative mills in producing regions:

TABLE 39

FAS	4/4	5/4		
No. 1 Com. and Sel	4/4	5/4	6/4	8/4
No. 2 Com	4/4	5/4		
No. 3 Com	4/4			
Log run	4/4	5/4	6/4	8/4

Unit Packages

Buckeye is usually a secondary sawmill product, and due to this fact the lumber is generally sold on a log run or mill run basis. However, some mills are in position to furnish the stock based upon grades. The lumber is tallied on actual board feet content and in some instances on a piece tally.

Shipping Weights

The weights for buckeye are as follows:

TABLE 40

BUCKEYE, YELLOW

(*Æsculus octandra*)

Weight per Cubic Foot: Green, 49; Air-dry (12% MC), 25 — Weights per Thousand Feet Surface Measure

(*Courtesy of Hardwood Manufacturers Institute*)

Thickness Inches (Actual)	*Green Weight (Note)*	*Per Cent of Moisture Content*					
		10%	12%	14%	16%	18%	20%
3/8	1531	773	781	790	797	805	812
13/32	1659	837	846	855	863	872	880
1/2	2042	1030	1042	1053	1062	1074	1083
17/32	2169	1095	1107	1119	1129	1141	1151
5/8	2552	1288	1302	1316	1328	1342	1354
11/16	2807	1417	1432	1448	1461	1476	1489
3/4	3062	1546	1562	1579	1594	1610	1625
13/16	3318	1674	1693	1711	1726	1745	1760
4/4	4083	2062	2083	2104	2125	2146	2167
17/16	4338	2190	2213	2237	2258	2281	2302
19/16	4849	2447	2474	2500	2523	2550	2573

NOTE: Green weights shown herein are predicated on the moisture content of the tree when felled.

To calculate weights at other moisture content see Index—Moisture Content.

Ordering

(See general discussion on this subject.)

Caution

Care must be taken in the storing of lumber in yards. The wood is susceptible to blue stain, but if precautions are taken and proper piling methods used, this trouble is greatly minimized.

Special Service Requirements

Buckeye is a relatively low-priced hardwood and can well be substituted for other species. Its weakness limits its use for construction purposes, but when required for purposes similar to basswood or poplar, where strength is not required, it will serve the purpose very well.

Specifications

The following publications may be consulted for information regarding specifications for yellow buckeye:

Standards and Specifications in the Wood-Using Industries—Bureau of Standards.
National Directory of Commodity Specifications—Bureau of Standards.

(See general Bibliography for publishers' addresses.)

Engineering Data

(See Table 2.)

Improvements

(See general discussion on this subject.)

Associations

The following associations will be glad to give information regarding lumber and other stock cut from buckeye:

National Hardwood Lumber Association (Grading rules and inspection service).
National Lumber Manufacturers Association (General information).
Hardwood Manufacturers Institute (Production figures and prices).

(See general list of Associations for addresses.)

Publications

The following publications frequently carry trade items regarding buckeye, prices, and other data:

American Lumberman
Hardwood Buyers Guide
Hardwood Record
Mississippi Valley Lumberman
New York Lumber Trade Journal, The
Pennsylvania Lumberman
Southern Lumberman

(See general list of Periodicals for publishers' addresses.)

Bibliography

The following books and articles may prove helpful to readers desiring further information:

American Forest Trees—Henry H. Gibson.
Lumber and Its Uses—R. S. Kellogg.
Handbook of the Trees of the Northern United States and Canada, East of the Rocky Mountains—R. B. Hough.

(See general Bibliography for publishers' addresses.)

Abbreviations and Terminology

(See general list of Abbreviations and Glossary.)

BUTTERNUT[1]

(A Hardwood)

Juglans cinerea

ANNUAL PRODUCTION (1928).....287,000 bd. ft.
AVERAGE VALUE OF LUMBER CUT AT MILL PER M.B.F. (1928).....$36.42
TIMBER STAND (1920).....1,000,000,000 bd. ft.

PRINCIPAL STATES PRODUCING CUT — IN ORDER OF IMPORTANCE (1928):

West Virginia, Tennessee, Indiana.

Range of Species

Southern New Brunswick to Delaware, and the Appalachian Mountains to Georgia and Alabama; westward through Ontario and upper peninsula of Michigan to eastern South Dakota, eastern Iowa, southeastern Nebraska, central Kansas, southern Missouri, and northern Arkansas.

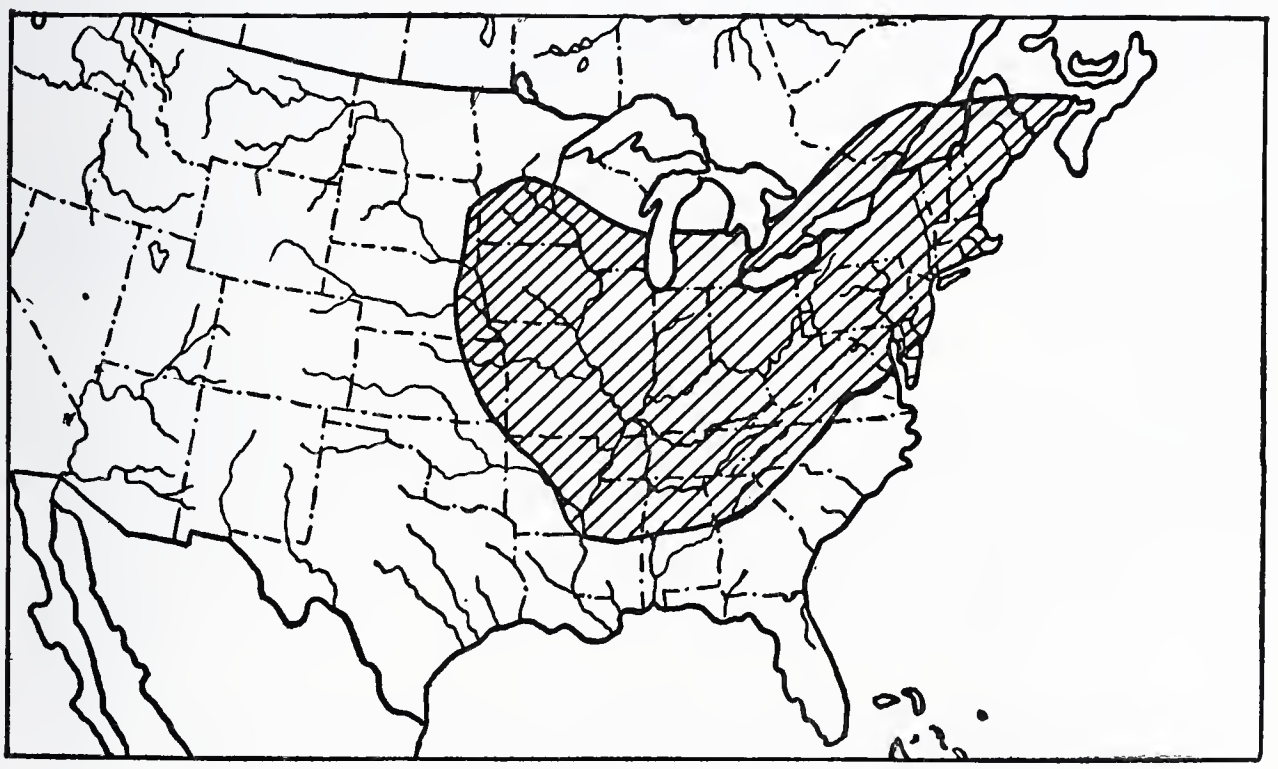


Illustration 23—General range of butternut.

Butternut, because of its similarity to black walnut, is often used interchangeably. Its importance as a commercial wood has increased due to the popularity of and increased demand for black walnut. In the forest its growth is scattered and it is more or less limited in its range.

[1] Butternut belongs to the same family and genus as black walnut. They are often confused in the trade.

Usual Names

Butternut White walnut

Also Called

Butternut (Me., N. H., Vt., Mass., R. I., Conn., N. Y., N. J., Pa., Del., W. Va., N. C., S. C., Ala., Ark., Ky., Tenn., Mo., Ill., Iowa, Ind., Mich., Minn., Wis., Kansas, Nebr., Ohio, Ontario)
White walnut (Del., Pa., Tenn., Va., W. Va., N. C., S. C., Ala., Ky., Mo., Ill., Ind., Wis., Iowa, Nebr., Minn., S. D.)
Walnut (Minn.)
Oil-nut (Me., Minn., N. H., S. C.)
Buttnut (N. J.)
Lemon walnut (lit.)
American white walnut (trade)

Description

The structure of butternut is similar to that of black walnut. It is of the semidiffuse-porous class of hardwoods; it is lighter and softer than black walnut and does not have the same color. Often a tendency towards brittleness is apparent.

The wood has a figure similar to black walnut, but the color is lighter, the heartwood of butternut being brown; sapwood much lighter (white to light brown). It is very susceptible to finishing, and with proper staining can be made to imitate black walnut. It glues well and can be veneered. The wood is coarse-grained, is easily worked, and does not impart odor or taste.

Uses

Butternut is now little used for rough construction purposes. A large per cent of the cut is used for the same purposes as black walnut. The following is a list of some of its important uses:

Cabinet work
Fixtures
Furniture manufacture
Molding and trim
Turned articles
Specialty boxes and containers

Classifications

Butternut is graded according to Standard Grading Rules for Walnut and Butternut, issued by the National Hardwood Lumber Association.

(See general list of Associations for addresses.)

Types and Sizes

The following grades and sizes represent butternut lumber which is most commonly cut and consumed by manufacturers and fabricators. It is available either air-dried or kiln-dried and is carried in stock by representative mills in producing regions:

TABLE 41

FAS	4/4	5/4		
No. 1 Com. and Btr	4/4	5/4	8/4	12/4
No. 1 Com. and Selects	4/4	6/4		
No. 2 Common	4/4			
No. 3 Common	4/4			
Log run	4/4	6/4	8/4	12/4

Unit Packages

Butternut is usually sold on standard grade basis. Often mills sell it, however, on mill or log run basis. The lumber is measured by board feet content tally, or export tally.

Shipping Weights

Weights for butternut lumber are as follows:

TABLE 42

BUTTERNUT
(*Juglans cinerea*)

Weight per Cubic Foot: Green, 46; Air-dry (12% MC), 27 Weights per Thousand Feet Surface Measure

(*Courtesy of Hardwood Manufacturers Institute*)

Thickness Inches (Actual)	*Green Weight (Note)*	*Per Cent of Moisture Content*					
		10%	12%	14%	16%	18%	20%
3/8	1438	835	844	852	862	870	878
13/32	1557	905	914	923	933	943	952
1/2	1917	1114	1125	1136	1149	1160	1171
17/32	2037	1183	1195	1207	1221	1233	1244
5/8	2396	1392	1406	1420	1436	1450	1464
11/16	2636	1531	1547	1562	1580	1595	1610
3/4	2875	1670	1687	1704	1723	1740	1757
13/16	3115	1810	1828	1846	1867	1885	1903
4/4	3833	2227	2250	2273	2296	2319	2342
17/16	4073	2366	2390	2414	2441	2465	2489
19/16	4552	2645	2671	2698	2728	2755	2782

NOTE: Green weights shown herein are predicated on the moisture content of the tree when felled.

To calculate weights at other moisture content see Index—Moisture Content.

Ordering

(See general discussion on this subject.)

Caution

(See general discussion on this subject.)

Special Service Requirements

Butternut does not command as high a price as black walnut in the market. It makes a good substitute for black walnut if properly stained and finished providing the other requisites of the latter species are not required.

Specifications

The following publications may be consulted for information regarding specifications for butternut:

Standards and Specifications in the Wood-Using Industries—Bureau of Standards.
National Directory of Commodity Specifications—Bureau of Standards.

(See general Bibliography for publishers' addresses.)

Engineering Data

(See Table 2.)

Improvements

(See general discussion on this subject.)

Associations

The following associations will be glad to give information regarding lumber and other stock cut from butternut:

National Hardwood Lumber Association (Grading rules and inspection service).
National Lumber Manufacturers Association (General information).
Hardwood Manufacturers Institute (Production figures and prices).

(See general list of Associations for addresses.)

Publications

The following publications frequently carry trade items regarding butternut, prices, and other data:

American Lumberman
Hardwood Buyers Guide
Hardwood Record
Lumbermen's Clearing House Buyers' Guide
New York Lumber Trade Journal, The
Pennsylvania Lumberman
Southern Lumberman
Veneers

(See general list of Periodicals for publishers' addresses.)

Bibliography

The following books and articles may prove helpful to readers desiring further information:

Lumber and Its Uses—R. S. Kellogg.
American Forest Trees—Henry H. Gibson.
Handbook of the Trees of the Northern United States and Canada, East of the Rocky Mountains—R. B. Hough.

(See general Bibliography for publishers' addresses.)

Abbreviations and Terminology

(See general list of Abbreviations and Glossary.)

BLACK CHERRY[1]

(A Hardwood)

Prunus serotina

ANNUAL PRODUCTION (1928).....6,654,000 bd. ft.
AVERAGE VALUE OF LUMBER CUT AT MILL PER M.B.F. (1928).....$60.78
TIMBER STAND (1928).....1,500,000,000 bd. ft.

PRINCIPAL STATES PRODUCING CUT—IN ORDER OF IMPORTANCE:
Pennsylvania, New York, West Virginia.

Range of Species

From Nova Scotia westward through Canada to the northern shores of Lake Superior; southward to Florida, and westward to North Dakota, eastern Nebraska, and Kansas, southwestern Arkansas, Oklahoma, and eastern and western Texas.

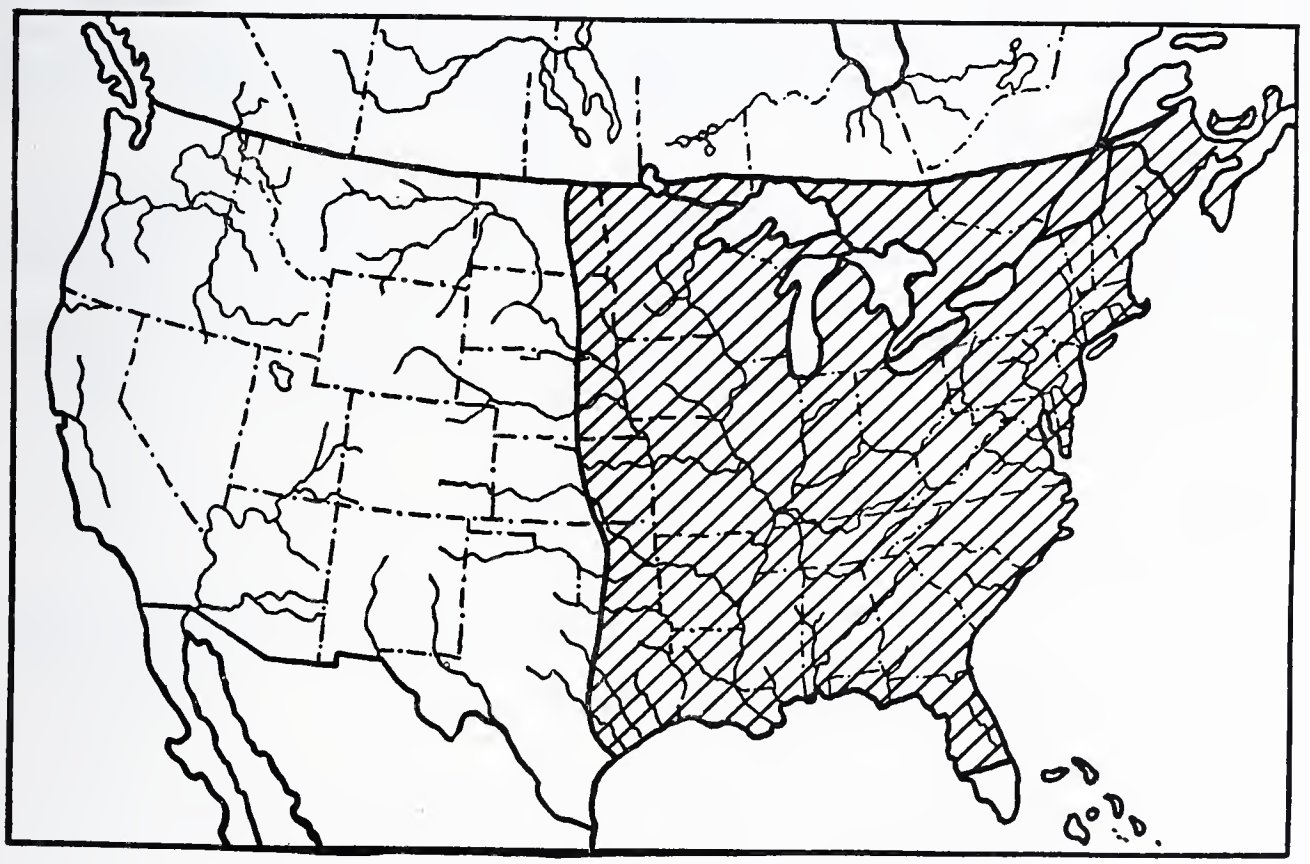


Illustration 24—General range of black cherry.

Cherry because of its relative scarcity is not at present used extensively, although it has excellent qualities for various purposes. This is perhaps due to the fact that in the forest its growth is scattered, and there is no sharply defined commercial range.

[1] The "cherry" family is made up of some twenty or more species. The cherry lumber of commercial importance is cut from one species—black cherry, *Prunus serotina*.

Usual Name

Black cherry

Also Called

Wild black cherry (Vt., Mass., R. I., N. Y., N. J., Del., Pa., N. C., Ala., Miss., La., Ky., Mo., Ill., Iowa, Wis., Kansas, Nebr., Minn., Ohio, S. D., Ont.)
Wild cherry (Conn., N. J., Pa., Del., W. Va., N. C., S. C., Ala., Fla., Tex., Ark., Ky., Ind., Ill., Iowa, Wis.)
Black cherry (Me., N. H., Vt., R. I., N. Y., Miss., Md., Va., N. C., Ky., Mich., Wis., Ind., Nebr.)
Rum cherry (N. H., Mass., R. I., Miss., Nebr.)
Whiskey cherry (Minn.)
Choke cherry (Mo., Wis., Iowa)
Cherry (trade)
Cabinet cherry

Description

Cherry wood is of the diffuse-porous type, with pores small and scattered. It does not have a pronounced figure, but in some cases burl is present. Its chief value is due to its color, finishing qualities, and luster. The heartwood is a rich reddish-brown, and the sapwood a light brown. The wood is somewhat lighter in weight and is a little softer than beech and birch. It is strong and hard and has excellent wearing qualities. It checks, shrinks, and warps but little.

Uses

The wood of cherry is used mostly for specialized purposes. It is used to a great extent for cabinet making and printers' blocks. Often it is used to imitate mahogany. The following are some of its important uses:

Interior trim	Base blocks for electrotype and printing plates
Cabinet making (panels, trays, etc.)	Cores for high-class panels
Tool handles	Turned products
Spirit levels	Brush backs
Patterns	Woodenware
Novelty articles (penholders, etc.)	Piano actions

Classifications

Cherry is graded in accordance with Standard Grading Rules for this species as issued by the National Hardwood Lumber Association.

(See general list of Associations for addresses.)

Types and Sizes

The following grades and sizes represent lumber which is most commonly cut and consumed by manufacturers and fabricators. The lumber is available either air-dried or kiln-dried, and is carried in stock by representative mills in all producing regions:

TABLE 43

FAS	4/4	5/4	6/4	10/4	12/4	16/4
No. 1 Common	4/4	5/4				
No. 2 Common	4/4					
No. 3 Common	4/4					
Log run	4/4	5/4	6/4 and up.			

Unit Packages

Cherry is often quoted and sold on a log run or mill run basis. This is due primarily to the small cut. However, it can be purchased on a straight grade basis.

It is tallied on board foot basis, and tallied by actual board feet content tally; export or piece tally.

Shipping Weights

The weights for cherry lumber are as follows:

TABLE 44

CHERRY, BLACK
(*Prunus serotina*)

Weight per Cubic Foot: Green, 46; Air-dry (12% MC), 35 — Weights per Thousand Feet Surface Measure

(*Courtesy of Hardwood Manufacturers Institute*)

Thickness Inches (Actual)	*Green Weight (Note)*	*Per Cent of Moisture Content*					
		10%	12%	14%	16%	18%	20%
3/8	1438	1084	1094	1105	1116	1127	1138
13/32	1557	1174	1186	1197	1209	1221	1232
1/2	1917	1445	1459	1474	1488	1502	1517
17/32	2037	1535	1550	1566	1581	1596	1612
5/8	2396	1806	1824	1842	1860	1878	1896
11/16	2636	1987	2006	2026	2046	2066	2086
3/4	2875	2167	2189	2210	2232	2254	2275
13/16	3115	2348	2371	2395	2418	2441	2465
4/4	3833	2888	2917	2946	2975	3005	3035
17/16	4073	3070	3101	3131	3162	3193	3223
19/16	4552	3431	3466	3500	3534	3568	3602

NOTE: Green weights shown herein are predicated on the moisture content of the tree when felled.

To calculate weights at other moisture content see Index—Moisture Content.

Ordering

(See general discussion on this subject.)

Caution

Cherry is a specialty wood and is greatly desired for use where beauty of color and hardness are required. Often small defects known as gum-specks are found in the wood, and these are hard to disguise in the case of natural finishing.

Special Service Requirements

Cherry after certain treatment looks very much like mahogany. On the other hand, other species are used to imitate cherry, particularly birch. Cherry is well adapted for use where hardness, beauty of color, etc., are required; also, where minimum shrinkage, warp, and twist after fabrication are desired.

Specifications

The following publications may be consulted for information regarding specifications for cherry:

Standards and Specifications in the Wood-Using Industries—Bureau of Standards.
National Directory of Commodity Specifications—Bureau of Standards.

(See general Bibliography for publishers' addresses.)

Engineering Data

(See Table 2.)

Improvements

(See general discussion under this subject.)

Associations

The following associations will be glad to give information regarding lumber and other stock cut from cherry:

National Hardwood Lumber Association.
Northern Hemlock and Hardwood Association.
National Lumber Manufacturers Association.
Hardwood Manufacturers Institute.

(See general list of Associations for addresses.)

Publications

The following publications frequently carry trade items regarding cherry, prices, and other data:

American Lumberman
Hardwood Buyers Guide
Hardwood Record
Lumber Trade Journal
New York Lumber Trade Journal, The
Pennsylvania Lumberman
Southern Lumberman
Veneers
Wood Working Industries

(See general list of Periodicals for publishers' addresses.)

Bibliography

The following books and articles may prove helpful to readers desiring further information:

American Forest Trees—Henry H. Gibson.
Lumber and Its Uses—R. S. Kellogg.

(See general Bibliography for publishers' addresses.)

Abbreviations and Terminology

(See general list of Abbreviations and Glossary.)

CHESTNUT[1]

(A Hardwood)

Castanea dentata

ANNUAL PRODUCTION (1928) ..... 259,769,000 bd. ft.
AVERAGE VALUE OF LUMBER CUT AT MILL PER M.B.F. (1928) $31.09
TIMBER STAND (1925) ..... 19,300,000,000 bd. ft.

PRINCIPAL STATES PRODUCING CUT — IN ORDER OF IMPORTANCE:

West Virginia, North Carolina, Virginia, Tennessee, Pennsylvania, Kentucky, Connecticut, Maryland, Massachusetts, Ohio, New York, Georgia.

Range of Species

From southern Maine to northwestern Vermont; southern Ontario and southern shores of Lake Ontario to southern Michigan; southward to Delaware and Ohio; southern Indiana and Illinois, and on the Appalachian Mountains to central Kentucky and Tennessee, northern Georgia, western Florida, central Alabama, and Mississippi.

Chestnut at one time was one of our most important hardwood species. It has a history that is unequaled among our forest trees. Chestnut is favored for a multitude of uses, ranging from fence posts to highly specialized use in musical instruments. In 1904 a disease, the chestnut blight, appeared which after research and study was found to have been brought to the United States from Asia. The first evidence of chestnut blight was in the northeast, and its slow but steady growth has spread until it has practically covered the commercial range of chestnut in this country, except in the southern part. Attempts to thwart its destructive action have been futile, and the ultimate complete infection of the present stand is inevitable.

The Forest Products Laboratory, Madison, Wisconsin, has carried on a series of tests with blight-killed chestnut, and it is evident that the blight fungus is not directly responsible for any reduction in the strength or quality of the timber. The disease girdles the tree and kills it, and does not affect the wood structure itself.

Although it is true that the chestnut blight has eliminated a large portion of the stand, there are many mills cutting it in the chestnut range, which are producing exceedingly high-grade lumber in a wide assortment of grades and sizes.

Since the present stand cannot be saved, the most imperative problem to be solved is the utilization of the blight-killed chestnut timber and the use of the unaffected, live timber to as large an extent as possible.

Usual Name

Chestnut

[1] Chestnut lumber in this country is produced from this species. It should not be confused with chinquapin, or chinquapin oak.

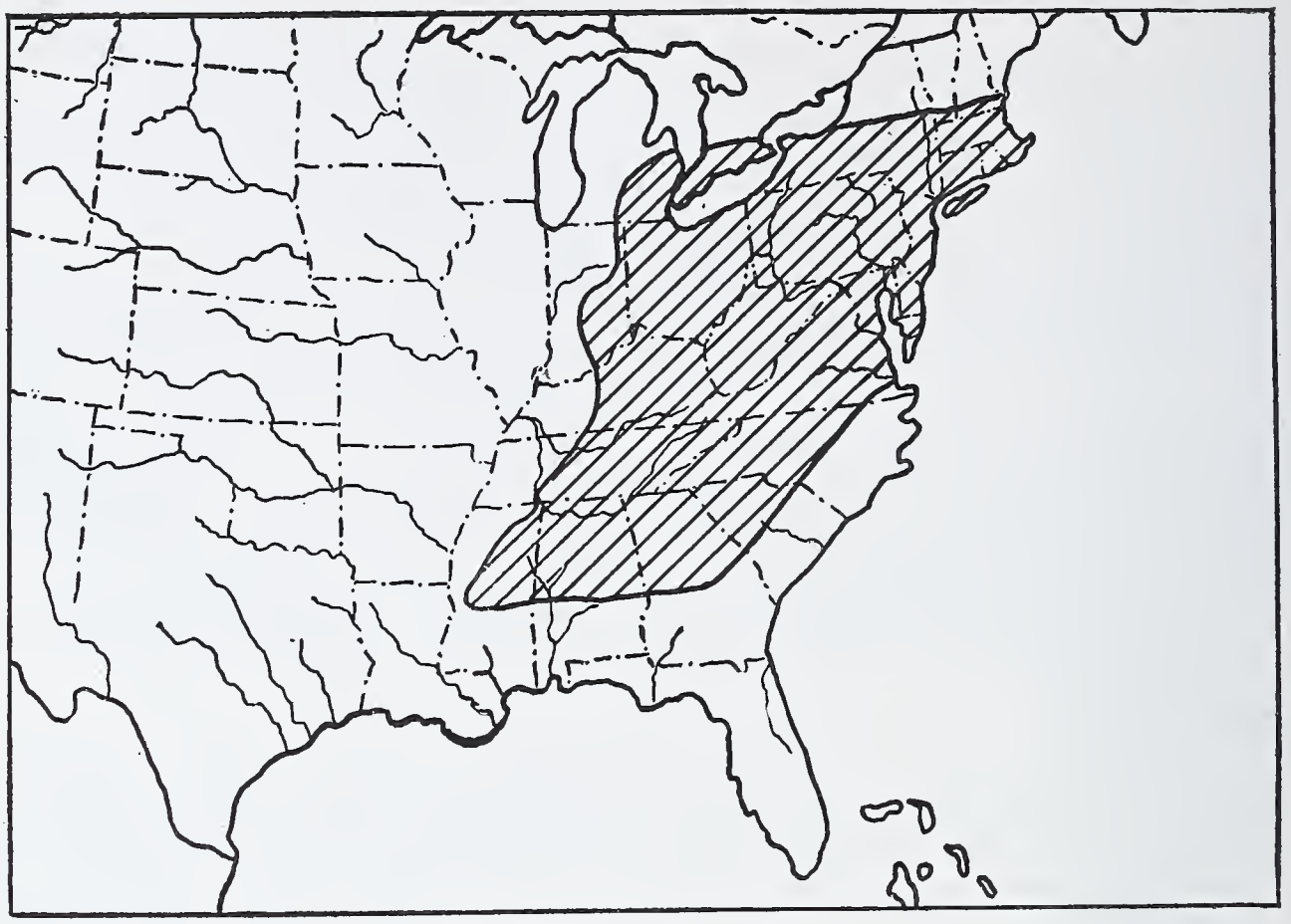


Illustration 25—General range of chestnut.

Also Called

Chestnut (Me., N. H., Vt., Mass., R. I., Conn., N. Y., N. J., Pa., Del., Md., Va., W. Va., N. C., Tenn., Ga., Ala., Miss., Ky., Mo., Mich., Ontario)
O-heh-yah-tah—"Prickly bur" (Indians, N. Y.)
American chestnut (lit. and hort.)
Sweet chestnut (lit.)

Description

The wood of chestnut is remarkable for its beauty of grain and color. It belongs to the ring-porous group of hardwoods and has large and distinct pores. The heartwood is a medium brown color; sapwood is usually very narrow and is lighter in color.

The wood is moderately light in weight, straight-grained, and has a tendency to split. It is easily dried and seasoned. It is not considered strong, but compares quite favorably with white pine, spruce, and hemlock.

Chestnut works well, but sometimes exhibits brashness. Among wood finishers it is a favorite, due not only to its figure, but its ability to take finishes, such as weather-staining and sand-blasting. Quartering does not improve the figure. Chestnut is very resistant to decay and has long been used for exterior purposes.

Uses

Chestnut formerly was used to a large extent for building and construction, particularly for heavy timbers, joists, and plates in mill and farm construction, due undoubtedly to its natural resistance to decay. It was also favored for fence posts and rails, tank stock, and numerous other exterior uses.

Today chestnut is more or less confined to industrial products, although large amounts are used annually for planing mill products. The following is a list of its principal uses:

Planing mill products
  interior trim, molding
  doors, trim parts
Core stock, veneer
Caskets and coffins
Furniture
  rustic, desks, chairs, tables, etc.
Office fixtures
Musical instruments
Toys and novelties
Boxes and crates
Core stock and paneling
Cross ties, poles, posts, piling

Chestnut wood is also a valuable source of tannin. It is used in the manufacture of pulp and paper and for distillation purposes.

Classifications

Chestnut is graded according to Standard Grading Rules for Chestnut, issued by the National Hardwood Lumber Association.

(See general list of Associations for addresses.)

Types and Sizes

The following grades and sizes represent lumber which is most commonly cut and consumed by manufacturers and fabricators. It is available either air-dried or kiln-dried, and is carried in stock by representative mills in producing regions:

TABLE 45

FAS	4/4	5/4	6/4	
No. 1 Com. and Select	4/4	5/4		
No. 2 Com	4/4	5/4	6/4	
No. 3 Com	4/4			
FAS Sound and Wormy, Qtd	4/4			
FAS Sound and Wormy, Plain	4/4			
Sound and Wormy, Plain	4/4	5/4	6/4	8/4
No. 2 Com. Sound and Wormy, Plain	4/4	5/4	6/4	
Crating	4/4	6/4		

Unit Packages

Chestnut is usually sold on standard grade classification, because of the wide range in value between the various grades. However, large amounts of chestnut are cut by the small, circular mills, and only in a few instances do these mills make any definite attempt to sort out their cut. Hence, this lumber is handled on log or mill run basis.

Tally is made on actual board feet contents. Some fabricators who are accustomed to purchasing strip chestnut, require a piece tally based on width and length.

Shipping Weights

Shipping weights for chestnut lumber are as follows:

TABLE 46

CHESTNUT

(*Castanea dentata*)

Weight per Cubic Foot, Green, 55; Air-dry (12% MC), 30 Weights per Thousand Feet Surface Measure

(*Courtesy of Hardwood Manufacturers Institute*)

Thickness Inches (Actual)	*Green Weight (Note)*	*Per Cent of Moisture Content*					
		10%	12%	14%	16%	18%	20%
3/8	1718	928	937	947	956	966	976
13/32	1862	1005	1015	1026	1036	1047	1057
1/2	2291	1237	1250	1262	1275	1288	1301
17/32	2434	1314	1328	1341	1355	1369	1382
5/8	2864	1546	1562	1578	1594	1610	1626
11/16	3150	1701	1718	1736	1753	1771	1789
3/4	3437	1855	1874	1894	1913	1932	1951
13/16	3723	2010	2031	2051	2072	2093	2114
4/4	4583	2475	2500	2525	2550	2576	2602
17/16	4869	2628	2655	2683	2710	2737	2764
19/16	5442	2937	2968	2998	3029	3059	3089

NOTE: Green weights shown herein are predicated on the moisture content of the tree when felled.

To calculate weights at other moisture content see Index—Moisture Content.

Ordering

Chestnut is more or less a specialty wood. When ordering, ascertain if the grade specified will meet the desired requirements.

For further information see general discussion on Ordering.

Caution

Unfortunately, chestnut is very susceptible to the attack of insects and worms. A special grade of "Sound and Wormy" (see Grading Rules for Hardwood Lumber) allows for these defects, and for many purposes this grade can be used economically. Chestnut lumber should be carefully handled due to its tendency to split.

Special Service Requirements

Chestnut offers a figure and finish that is well adapted for decorative purposes where these properties are important. Its ability to take various stains is made use of in furniture fabrication.

The lower grades of chestnut can be used economically for various purposes where clear lumber is not required and where strength is not necessary. Its high resistance to decay makes it particularly desirable for use where this factor must be considered.

Specifications

The following publications may be consulted for information regarding specifications for chestnut:

Standards and Specifications in the Wood-Using Industries—Bureau of Standards.

National Directory of Commodity Specifications—Bureau of Standards.

(See general Bibliography for publishers' addresses.)

Engineering Data

(See Table 2.)

Improvements

(See general discussion on this subject.)

Associations

The following associations will be glad to give information regarding lumber and other stock cut from chestnut:

National Hardwood Lumber Association (Grading rules and inspection service).
Hardwood Manufacturers Institute (Production figures and prices).
National Lumber Manufacturers Association (General information).
Appalachian Hardwood Club (General information).

(See general list of Associations for addresses.)

Publications

The following publications frequently carry trade items regarding chestnut, prices, and other data:

American Lumberman
Hardwood Buyers Guide
Hardwood Record
Lumber Trade Journal
Lumbermen's Clearing House Buyers' Guide
Memphis Lumberman and Southern Woodworker
Millwork
Mississippi Valley Lumberman
New York Lumber Trade Journal, The
Pennsylvania Lumberman
Southern Lumberman
Southern Lumber Journal
Veneers

(See general list of Periodicals for publishers' addresses.)

Bibliography

The following books and articles may prove helpful to readers desiring further information:

"The American Chestnut Tree"—S. B. Detwiler—*American Forestry Magazine*, Oct., 1915.
Chestnut and Chestnut Blight in North Carolina—P. L. Buttrick, E. H. Frothingham, G. F. Gravatt, and Murray Bruner.
Uses for Chestnut Timber Killed by the Bark Disease—J. C. Nellis.
"The Present Chestnut Problem in the South"—L. S. Gill and R. B. Clapper, *Southern Lumberman*, May 5, 1928.
American Forest Trees—Henry H. Gibson.

(See general Bibliography and list of Periodicals for publishers' addresses.)

Abbreviations and Terminology

(See general list of Abbreviations and Glossary.)

COTTONWOOD

(A Hardwood)

EASTERN COTTONWOOD *Populus deltoides*	BLACK COTTONWOOD *Populus trichocarpa*
SOUTHERN COTTONWOOD *Populus deltoides virginiana*	SWAMP COTTONWOOD *Populus heterophylla*

ANNUAL PRODUCTION (1928).....143,562,000 bd. ft.
AVERAGE VALUE OF LUMBER CUT AT MILL PER M.B.F. (1928) $27.54
TIMBER STAND (1925).....All species 7,500,000,000 bd. ft.
(20% aspen)

PRINCIPAL STATES PRODUCING CUT—IN ORDER OF IMPORTANCE (1928):

Minnesota, Mississippi, Louisiana, Tennessee, Arkansas, Texas, Alabama, South Carolina.

Range of Species

Eastern Cottonwood:

From Vermont; western New York; Pennsylvania; Maryland; central-eastern Mississippi; range imperfectly known.

Southern Cottonwood:

From Quebec and Lake Champlain southward through western New England to Florida; westward to southern Minnesota, the Dakotas, eastern Nebraska and Kansas, Oklahoma, and Texas.

Black Cottonwood:

California (west slope of Sierra Nevada and coast ranges to San Diego County); coast islands; Lower California; (San Pedro Martir Mountains).

Swamp Cottonwood:

From Connecticut (Southington), New York (Essex, Clinton and Franklin counties), and Long Island (Northport) southward near the coast to southern Georgia and western Florida (Apalachicola River); westward in Gulf region to western Louisiana and through Arkansas to southeastern Missouri, western Kentucky and Tennessee, and southern Illinois and Indiana, and in Ohio (Williams, Ottawa, Knox, Logan, Shelby, Richland, Auglaize, Licking, and Lake counties).

Cottonwood is a species greatly confused in the industry, and known by many names. It belongs to the true poplar, or Populus, family. In all, there are fifty or more varieties and species. For commercial purposes the bulk of cottonwood lumber is produced from the so-called eastern cottonwood, and black cottonwood; also, swamp cottonwood.

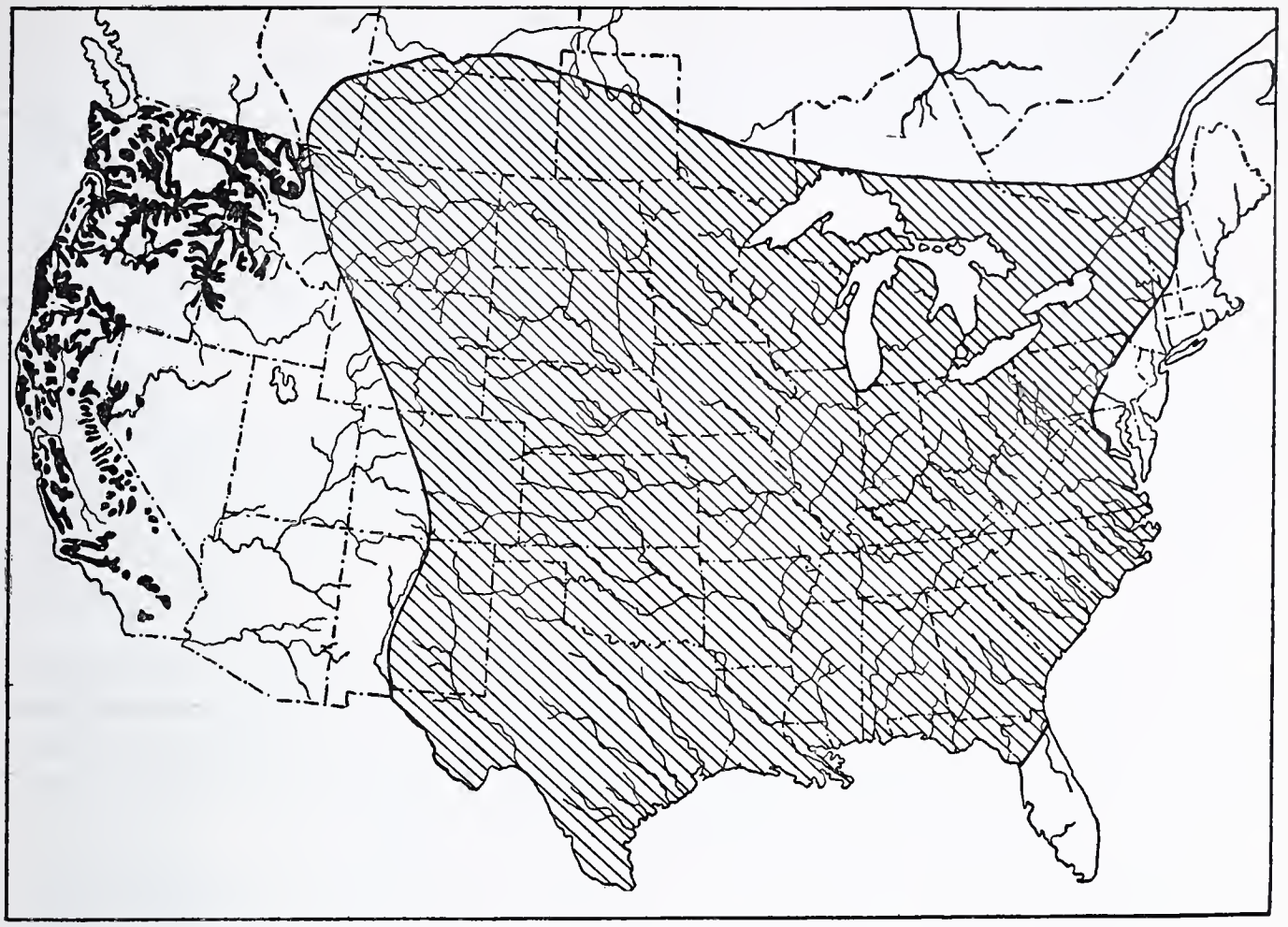


Illustration 26—General ranges of the cottonwoods. Black area indicates range of black cottonwood.

The aspen, perhaps one of the best known and widely distributed trees in North America, belongs to this same family, and approximately 20 per cent of the total cut of cottonwoods is obtained from this species. Large quantities of the species (aspen) are consumed for pulp.

Cottonwood is a naturally water-loving tree, and frequents river bottoms and wet sites in general. It has a quick growth, and is not particularly a long-lived tree, forty to fifty years often representing its complete maturity.

Cottonwood has come into its own as an important hardwood species within the last thirty-five or forty years.

Usual Name

Cottonwood

Also Called

Eastern Cottonwood:

Cottonwood Eastern cottonwood (lit.)

Southern Cottonwood:

Cottonwood (N. H., Vt., Mass., R. I., N. Y., Pa., Md., Miss., N. J., W. Va., Ky., Mo., Ill., Wis., Kans., Nebr., Iowa, Minn., Mich., Ohio, Ontario, N. Dak., S. Dak., trade)

Big cottonwood (Nebr.)
Yellow cottonwood (Ark., Iowa, Nebr.)
Cotton-tree (N. Y.)
Carolina poplar (Pa., Ind., Ohio)
Vermont poplar (Vt.)
Whitewood (Iowa)
Aspen cottonwood (N. C.)
Necklace poplar
Water poplar
River poplar
Southern cottonwood (lit.)

Black Cottonwood:

Black cottonwood
Cottonwood (Calif., trade)
Balm cottonwood (Calif.)

Swamp Cottonwood:

River cottonwood (R. I., Miss., La., Ohio)
Swamp cottonwood (S. C., Miss., Del.)
Black cottonwood (Ala.)
Cottonwood (N. Y., Va., N. C., S. C., Miss.)
Downy poplar (Tenn., Ala., Ark.)
Swamp poplar (N. J.)
Cotton-tree (N. C.)
Liar (La.)
Langues de femmes (La.)
Cotton gum (N. C.)

Description

The wood of the several species of cottonwoods is similar in structure, and the species are not separated in the trade. Variations, however, occur, as can be expected in any tree family where a large number of species and varieties are represented. The cottonwoods belong to the diffuse-porous hardwoods. The color ranges from grayish-white to light brown; sapwood is not clearly defined and merges gradually into the heartwood.

The wood is light in weight and, although not exceedingly strong, is tough when thoroughly dried. It is close-grained, even-textured, and straight-grained. It is easily worked and does not split easily. Little difficulty is experienced in seasoning and kiln-drying, although the wood tends to warp and twist unless properly handled.

The wood of cottonwood veneers exceedingly well, and holds nails and screws. It also glues readily. It does not have taste or odor after it is thoroughly dried. It can be readily stained and reacts well to finishing.

It has low resistance to decay, and hence is little used for purposes where it will be in contact with the ground, or exposed to the weather, unless properly treated with preservatives.

Uses

Cottonwood is a favorite wood for boxes and veneered containers. It is estimated that approximately one-half of the total cut is used for these purposes. The balance goes into many specialty products. Its use for building and construction is limited, but it is sometimes used for millwork products. Some goes into vehicle and body parts, farm implements, laundry appliances, etc. Large quantities are used in the manufacture of excelsior, and for pulp and paper purposes.

Classifications

Cottonwood lumber is graded under *Standard Grading Rules for Sap Gum, Cottonwood, Black Gum, Tupelo, Magnolia, Willow, and Aspen,* issued by the National Hardwood Lumber Association.

(See general list of Associations for addresses.)

Types and Sizes

The following grades and sizes represent cottonwood lumber which is most commonly cut and consumed by manufacturers and fabricators. It is available either air-dried or kiln-dried, and is carried in stock by representative mills in producing regions.

TABLE 47

FAS	4/4	8/4	10/4
No. 1 Common and Select	4/4	5/4	10/4
No. 2 Common	4/4	5/4	
No. 3 Common	4/4		
Box Boards	4/4 (13″–17″ wide)		
FAS	4/4 (13″ and wider)		

Unit Packages

Cottonwood is usually sold on a standard grade basis. It is measured by actual board feet content tally. For export purposes a piece tally (length and width) is often made (see discussion under Hardwood Grading Rules).

Shipping Weights

TABLE 48

COTTONWOOD, EASTERN
(*Populus deltoides*)

Weight per Cubic Foot: Green, 49; Air-dry (12% MC), 29 — Weights per Thousand Feet Surface Measure

(*Courtesy of Hardwood Manufacturers Institute*)

Thickness Inches (Actual)	*Green Weight (Note)*	*Per Cent of Moisture Content*					
		10%	12%	14%	16%	18%	20%
3/8	1531	898	906	916	924	934	943
13/32	1659	972	982	992	1001	1011	1022
1/2	2042	1197	1208	1221	1232	1245	1258
17/32	2169	1272	1284	1297	1309	1323	1336
5/8	2552	1496	1510	1526	1540	1556	1572
11/16	2807	1646	1661	1679	1694	1712	1729
3/4	3062	1795	1812	1831	1848	1867	1886
13/16	3318	1945	1963	1984	2002	2023	2044
4/4	4083	2393	2417	2441	2465	2490	2515
17/16	4338	2543	2567	2594	2618	2645	2672
19/16	4849	2842	2869	2899	2926	2956	2987

NOTE: Green weights shown herein are predicated on the moisture content of the tree when felled.

To calculate weights at other moisture content see Index—Moisture Content.

TABLE 49

COTTONWOOD, BLACK

(*Populus trichocarpa*)

Weight per Cubic Foot: Green, 46; Air-dry (12% MC), 24 Weights per Thousand Feet Surface Measure

(*Courtesy of Hardwood Manufacturers Institute*)

Thickness Inches (Actual)	*Green Weight (Note)*	*Per Cent of Moisture Content*					
		10%	12%	14%	16%	18%	20%
3/8	1438	743	750	757	766	773	780
13/32	1557	805	813	820	829	837	845
1/2	1917	990	1000	1010	1021	1030	1040
17/32	2037	1052	1063	1073	1085	1095	1105
5/8	2396	1238	1250	1262	1276	1288	1300
11/16	2636	1362	1375	1388	1404	1417	1430
3/4	2875	1486	1500	1514	1531	1546	1560
13/16	3115	1609	1625	1641	1659	1674	1690
4/4	3833	1980	2000	2020	2040	2060	2081
17/16	4073	2105	2125	2145	2169	2190	2210
19/16	4552	2352	2375	2398	2424	2447	2470

NOTE: Green weights shown herein are predicated on the moisture content of the tree when felled.

To calculate weights at other moisture content see Index—Moisture Content.

Shipping weights for black cottonwood are a little lighter than for eastern cottonwood.

Ordering

(Follow general instructions under Ordering.)

Caution

Cottonwood has a tendency to stain, and care should be taken to handle it in such a way as to minimize this danger. In the lower grades—No. 2 and No. 3 common—sound cuttings instead of clear cuttings are allowed.

Careful seasoning methods will reduce the tendency of cottonwood to warp and twist.

Special Service Requirements

Cottonwood can be used for many purposes where similar species are now being used. It is particularly adaptable for veneer work, container, box, and crate manufacture. It is an ideal wood for industrial use, due to its many favorable properties.

It is available as "box boards" (refer to Hardwood Grading Rules) for specialty work.

It should be remembered that cottonwood is not considered as a resistant wood, and should always be given preservative treatment if used for exterior purposes under conditions which are favorable to decay.

Specifications

The following publications may be consulted for information regarding specifications for cottonwood:

Standards and Specifications in the Wood-Using Industries—Bureau of Standards.
National Directory of Commodity Specifications—Bureau of Standards.

(See general Bibliography for publishers' addresses.)

Engineering Data

(See Table 2.)

Improvements

Mills and fabricators have experienced considerable difficulty with this wood in regard to its seasoning and kiln-drying. Mill studies have been made which have developed proper procedure for kiln-drying, however, which has minimized warp, twist, sap staining, etc.

For additional information refer to discussion under Improvements.

Associations

The following associations will be glad to give information and data regarding lumber and other stock cut from cottonwood:

National Hardwood Lumber Association (Grading rules).
Hardwood Manufacturers Institute (Production figures and prices).
National Lumber Manufacturers Association (General information).

(See general list of Associations for addresses.)

Publications

The following publications frequently carry trade items regarding cottonwood, prices, and other data:

American Lumberman
Gulf Coast Lumberman
Hardwood Buyers Guide
Hardwood Record
Lumber Trade Journal
Lumbermen's Clearing House Buyers' Guide
Memphis Lumberman and Southern Woodworker
New York Lumber Trade Journal, The
Southern Lumberman
Southern Lumber Journal
Wood Working Industries

(See general list of Periodicals for publishers' addresses.)

Bibliography

The following books and articles may prove helpful to readers desiring further information:

Cottonwood in the Mississippi Valley—A. W. Williamson.
"Cottonwood"—Forest Service Leaflet, *American Woods Series.*
Swamp Cottonwood—Silvical Leaflet No. 40, Forest Service.
American Forest Trees—Henry H. Gibson.
Lumber and Its Uses—R. S. Kellogg.

(See general Bibliography for publishers' addresses.)

Abbreviations and Terminology

(See general list of Abbreviations and Glossary.)

DOGWOOD[1]

(A Hardwood)

Cornus florida

Annual Production (1928).....20,000 cords, and 100,000 ft. of dimension lumber, etc.

Average Value of Lumber Cut at Mill per M.B.F. (1928): Figure not available

Timber Stand (1926) (Estimated).....231,000 cords, or approximately 115,000,000 bd. ft.[2]

Principal States Producing Cut—in Order of Importance:

Tennessee, North Carolina.

Range of Species

Southeastern Maine to Central Florida and west through southern New York, Michigan, and Wisconsin, southeastern Iowa to southeastern Kansas, eastern Oklahoma, and eastern Texas.

Dogwood is a highly specialized wood, and is in constant demand in this country and for export purposes. The stand is limited. At the present rate of consumption it is estimated by the U. S. Forest Service that it will last approximately fifteen to twenty years. Dogwood is a most important wood for the manufacture of specialty products for the textile industry.

Usual Names

Dogwood
Flowering dogwood

Also Called

Flowering dogwood (Mass., R. I., N. Y., N. J., Del., Pa., Va., N. C., S. C., Miss., La., Ark., Mo., Ill., Kans., Mich., Ont., Ohio, Ind.)
Dogwood (N. J., Pa., Del., W. Va., N. C., S. C., Ala., Fla., La., Ky., Ohio., Ind., Mich.)
Boxwood (Conn., R. I., N. Y., Miss., Mich., Ky., Ind., Ont.)
False box-dogwood (Ky.)
New England boxwood (Tenn.)
Flowering Cornel (R. I.)
Cornel (Tex.)
False boxwood (lit.)
White cornel
Arrowwood
Indian arrowwood
Florida dogwood

[1] The bulk of the dogwood lumber now being produced is cut from this species. There are three other species of lesser importance.

[2] This figure is computed by estimating one cord as equivalent to 500 board feet.

Description

The wood of dogwood and persimmon is quite similar in that both species are very heavy, very hard, and fairly straight-grained. In actual wood structure, however, they are quite different. Dogwood belongs to the diffuse-porous wood while persimmon is ring-porous in structure. The ring growth is quite narrow in both woods. However, persimmon is not quite so uniform and fine-textured as dogwood. The amount of sapwood and heartwood varies considerably. The average log is composed largely of sapwood.

A general summary of the properties of the wood is given in the following table:

TABLE 50

COMPARATIVE PROPERTIES OF DOGWOOD AND PERSIMMON

Color of Wood	*Wood Structure*	*Weight or Density*	*Stiffness*	*Shrinkage*	*Workability*	*Ease in Gluing*	*Kiln-drying*
			DOGWOOD				
Heartwood varies from reddish-br. to chocolate br. Sapwood ranges from pinkish to light br.	Fine-textured and uniform	Very heavy Slightly heavier than persimmon	Stiffer than persimmon	Severe Greater than persimmon	Hard to work More difficult than persimmon	Very difficult to glue	Very difficult to dry
			PERSIMMON				
Heartwood dark greenish-yellow, often streaky. Sapwood creamy wh. when freshly cut, later turning to greenish-yellow	Not as fine textured and uniform as dogwood	Very heavy Usually lighter than dogwood	Not as stiff as dogwood	Great degree of shrinkage Less than in dogwood	Rather hard to work, but not as difficult as dogwood	Difficult to glue Less difficult than dogwood	Difficult to dry

Uses

Dogwood is highly prized for the manufacture of shuttle blocks. The following is a list of its important uses:

Shuttles and shuttle blocks
Small pulleys
Mallet heads
Mine sprigs and rollers
Flyer blocks
Jewelers' blocks and sticks
Spool and bobbin heads
Skewer or bobbin spindles
Turnpins
"Quills" (for silk weaving)
Handles, and miscellaneous dimension products

Classifications

There are no standard rules for the grading of dogwood and persimmon. Bolts and logs are generally classified according to grades established by producers and consumers.

Flitches and dimension squares are generally graded under buyers' specifications, or special grading rules.

Types and Sizes

No standard-sized pieces are available. Generally dimension stock is cut in rough blocks of varying sizes, subject to further fabrication.

Flitches generally vary from two inches thick and up, as required by buyers.

Unit Packages

Dogwood is sometimes sold in cants or flitches, or rough blocked. Generally, the wood is cut into bolts ranging from 4 inches and up, to a maximum size. These are shipped directly to special dimension mills, where they are band-sawed into the various specialty products.

Usually buyers of bolts limit the size of pieces, and also the amount of heartwood. Bolts vary from 4 to 5 feet long.

Shipping Weights

The following table indicates shipping weights for dogwood lumber and flitches:

TABLE 51

DOGWOOD, FLOWERING
(*Cornus Florida*)

Weight per Cubic Foot: Green, 64; Air-dry (12% MC), 51 — Weights per Thousand Feet Surface Measure

(*Courtesy of Hardwood Manufacturers Institute*)

Thickness Inches (Actual)	*Green Weight (Note)*	*Per Cent of Moisture Content*					
		10%	12%	14%	16%	18%	20%
3/8	2000	1578	1594	1610	1626	1642	1658
13/32	2167	1710	1726	1745	1762	1778	1797
1/2	2667	2104	2125	2147	2168	2189	2211
17/32	2834	2236	2258	2281	2304	2326	2349
5/8	3334	2630	2656	2684	2710	2736	2764
11/16	3667	2893	2922	2952	2981	3010	3040
3/4	4001	3156	3187	3221	3252	3283	3317
13/16	4334	3419	3453	3489	3523	3557	3593
4/4	5333	4207	4250	4293	4336	4379	4423
17/16	5668	4471	4515	4563	4607	4651	4699
19/16	6335	4997	5046	5100	5149	5198	5252

NOTE: Green weights shown herein are predicated on the moisture content of the tree when felled.
To calculate weights at other moisture content see Index—Moisture Content.

A cord of dogwood is generally considered as weighing from 5,000 to 5,500 pounds, depending upon its cubic feet contents. A cord, consisting of approximately 128 cubic feet of solid wood substance, weighs approximately 5,000 pounds.

Ordering

In the purchase of dogwood care should be exercised to deal with those mills or individuals who specialize in this species.

Specifications and orders should be exact, and should definitely state limitations in size of stock, defects, amounts of heartwood permissible, etc.

Caution

Dogwood is a highly specialized species. Extreme care is required to season the stock properly. This particularly applies to kiln-drying. Dogwood also requires careful handling in manufacturing in order to avoid excessive waste in fabrication.

Trees and bolts are very susceptible to bursting and checking if exposed directly to the hot sun and drying winds.

Special Service Requirements

Dogwood offers remarkable hardness, toughness, and other properties which make it exceedingly resistant to abrasion. Under constant wear it becomes extremely smooth, slightly smoother than persimmon.

Manufacturers prefer the sapwood because of the cleaner appearance of the wood. There is no difference in the strength and other mechanical properties (moisture content being the same) between the heartwood and sapwood, and heartwood can be used for the same purposes as sapwood.

Specifications

Specification data on dogwood and persimmon are very meager. Manufacturers using these species generally write their own specifications.

Engineering Data

(See Table 2.)

Improvements

Producers of dogwood and persimmon put forth special efforts to cut selected timber in order to produce bolts and logs conforming to the buyers' specifications. Care is exercised in preventing excessive damage and degrade (splitting and checking) because of improper handling and seasoning.

Associations

The following associations can be consulted for information on lumber and other stock cut from dogwood:

Dogwood and Persimmon Association (General information).
Hardwood Manufacturers Institute (Production figures, sources, prices, etc.).
National Hardwood Lumber Association (General information).
National Lumber Manufacturers Association (General data).

(See general list of Associations for addresses.)

Publications

The following publications carry trade items regarding dogwood, prices, etc., and other data:

American Lumberman
Hardwood Buyers Guide
New York Lumber Trade Journal, The
Hardwood Record
Southern Lumberman

(See general list of Periodicals for publishers' addresses.)

Bibliography

The following books and articles may prove helpful to readers desiring further information:

Utilization of Dogwood and Persimmon—John B. Cuno.
American Forest Trees—Henry H. Gibson.
Lumber and Its Uses—R. S. Kellogg.

(See general Bibliography for publishers' addresses.)

Abbreviations and Terminology

Dogwood is seldom abbreviated.

(See general list of Abbreviations and Glossary.)

THE ELMS[1]

(Hardwoods)

AMERICAN (WHITE) ELM	ROCK (CORK) ELM	SLIPPERY ELM
Ulmus americana	*Ulmus racemosa*	*Ulmus fulva*

ANNUAL PRODUCTION (1928) ..... 155,903,000 bd. ft.
AVERAGE VALUE OF LUMBER CUT AT MILL PER M.B.F. (1928) $37.89
TIMBER STAND (1925) ..... 16,000,000,000 bd. ft.
PRINCIPAL STATES PRODUCING CUT — IN ORDER OF IMPORTANCE (1928):
Wisconsin, Michigan, Arkansas, Tennessee, Indiana, Mississippi, Louisiana, Ohio.

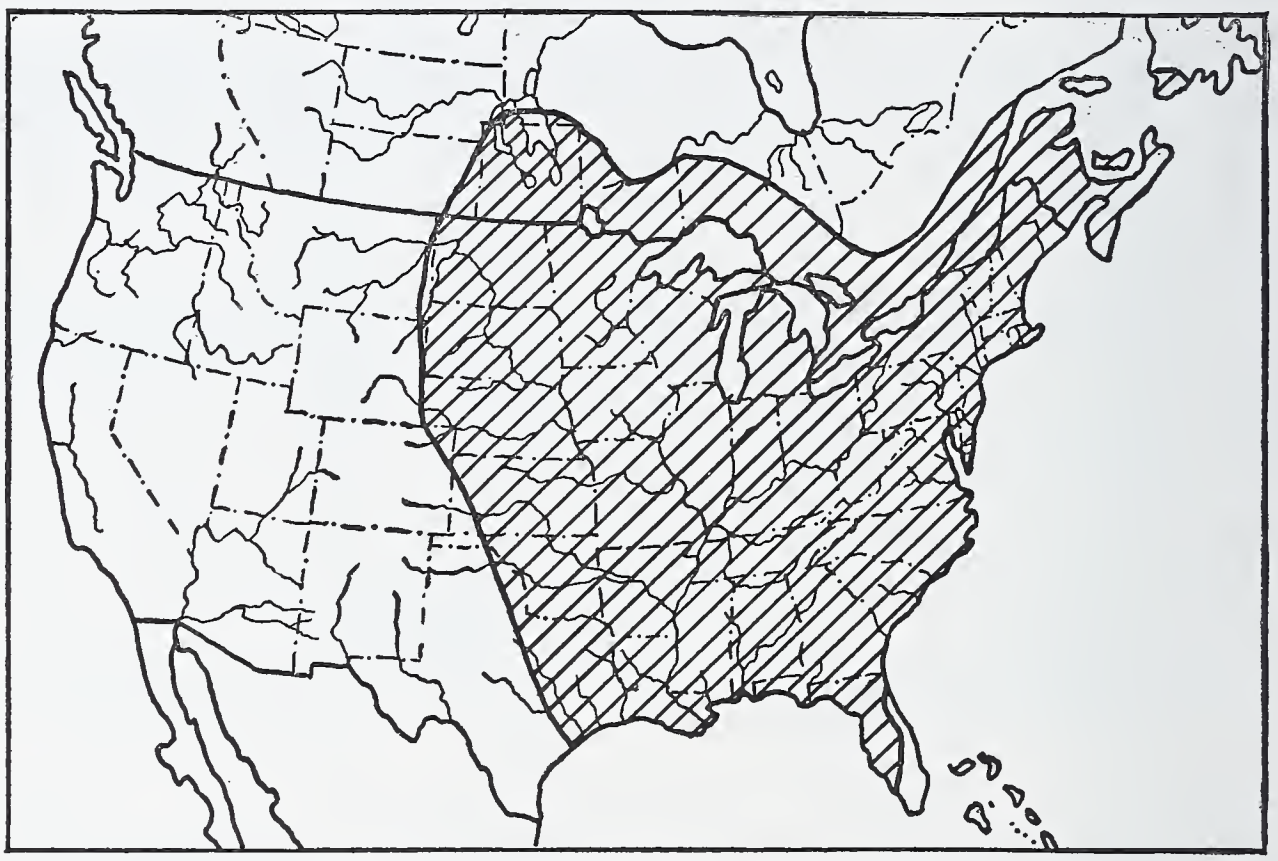


Illustration 27—General range of American (white) elm.

Range of Species

American (White) Elm:

From southern Newfoundland to Lake Superior and to the eastern base of the Rocky Mountains; south to Florida; west to North Dakota, South Dakota, western Nebraska, central Kansas, Oklahoma, southwestern Arkansas, and Texas.

[1] Six species of the elms occur in the United States. The species producing the bulk of the cut are indicated above. The trade frequently specifies "soft elm" or "rock elm." Wing elm and cedar elm are of little importance commercially and are not discussed here.

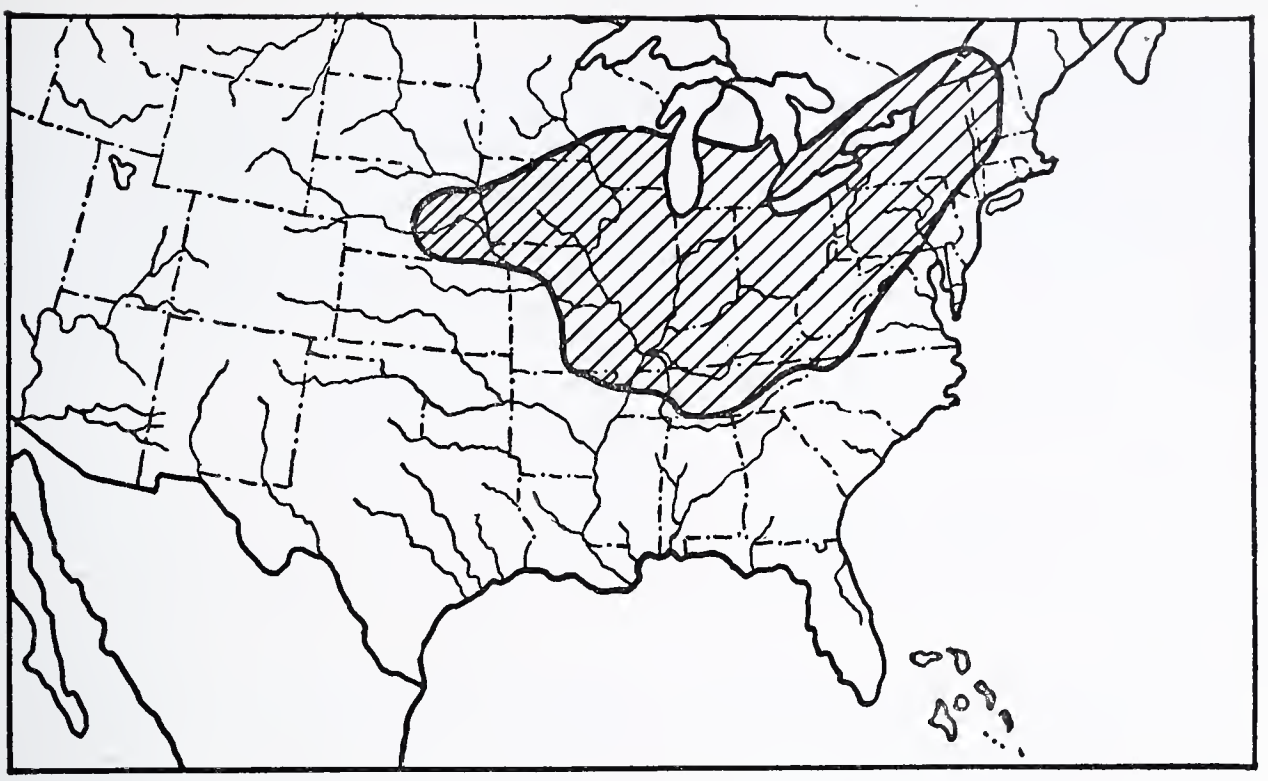


Illustration 28—General range of rock (cork) elm.

Rock (Cork) Elm:

From Quebec through Ontario and south through northwestern New Hampshire to southern Vermont; and to northern New Jersey; westward through northern New York, southern Michigan, central Wisconsin, and southwestern Minnesota to northeastern Nebraska, western Missouri, eastern Kansas, and middle Tennessee.

Slippery Elm:

From lower St. Lawrence River through Ontario to South Dakota and eastern Nebraska, southeastern Kansas, southwestern Arkansas, and Oklahoma; south to western Florida, central Alabama, and Mississippi, western Louisiana, and Texas.

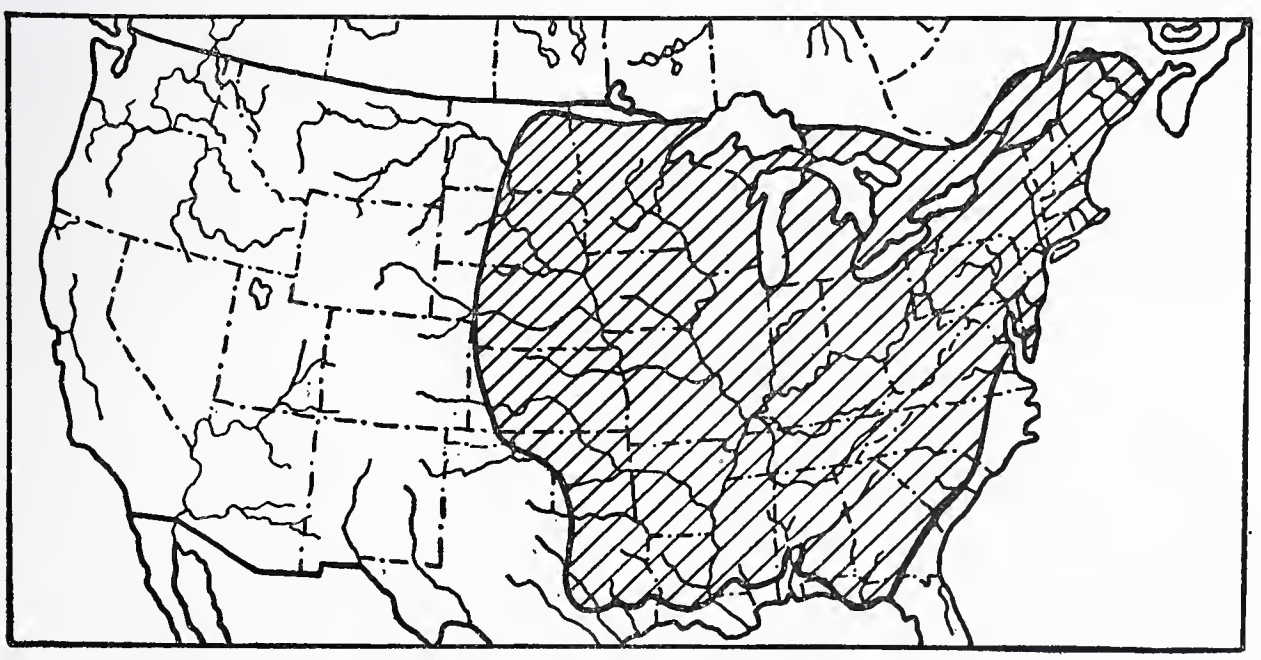


Illustration 29—General range slippery (red) elm.

Wing elm, cedar elm, and red elm are scattered throughout the southeastern part of the United States.

The elms are considered as one of the most important commercial species for specialty purposes. The tree is found scattered in the forest, growing in association with other important hardwoods. It is a typical tree of the region east of the Rocky Mountains. The bulk of the timber now available is in the Mississippi Valley and the Lake States. The species in general is gradually growing scarcer. It has been estimated that approximately three-fourths of the total stand of the elms is made up of American (or white) elm.

The elms, unfortunately, have a multitude of commercial and trade names. Most of these vary according to the different regions where the timber is cut.

Usual Names

American elm—white elm, gray elm, soft elm
Rock elm—cork elm, hard elm
Slippery elm—red elm, slippery elm

Also Called

American Elm:

American elm (Vt., Mass., R. I., N. Y., Del., Pa., N. C., Miss., Tex., Ill., Ohio, Kans., Nebr., Mich., Minn., Ont.)
White elm (Me., N. H., Vt., Mass., R. I., N. Y., Pa., N. J., Del., Md., Va., W. Va., N. C., S. C., Ala., Fla., Miss., La., Tex., Ark., Ky., Mo., Ill., Ind., Kans., Nebr., Ohio, Ont., Iowa, Mich., Minn., N. Dak., S. Dak., Mont.)
Water elm (Miss., Tex., Ark., Mo., Ill., Iowa, Mich., Ky., Ohio, Minn., Nebr.)
Elm (Mass., R. I., Conn., N. J., Pa., N. C., S. C., Iowa, Wis., Mont.)
Orme maigre (La.)
Swamp elm
Rock elm
Springwood (N. C.)
Gray elm (trade, lit.)
Soft elm (trade)
Hard gray elm (trade)

Rock Elm:

Cork elm (Vt., Mass., R. I., N. Y., N. J., Ark., Ohio, Iowa)
Rock elm (R. I., W. Va., Ky., Mo., Ill., Wis., Iowa, Mich., Nebr., Ont.)
Hickory elm (Mo., Ill., Ind., Iowa)
White elm (Ont.)
Thomas elm (Tenn., Ohio)
Northern cork barked elm (Tenn.)
Cork bark elm (N. Y.)
Northern cork elm (Vt.)
Wahoo (Ohio)
Cliff elm (Wis., Ky.)
Corky white elm
Corky-barked elm (Ohio)
Corky elm (W. Va.)

Slippery Elm:

Slippery elm (Vt., N. H., Mass., R. I., N. Y., N. J., Pa., Del., Md., Va., W. Va., N. C., S. C., Fla., Ala., Ga., Miss., La., Tex., Ky., Mo., Kans., Nebr., Ohio, Ill., Ind., Wis., Mich., Iowa, Minn., Ont.)
Red elm (Vt., Mass., N. Y., Del., Pa., W. Va., S. C., Ala., Miss., La., Tex., Ark., Ky., Mo., Ill., Kans., Nebr., Iowa, Ohio, Ont., Wis., Mich., Minn.)
Red-wooded elm (Tenn.)
Rock elm (Tenn.)
Orme gras (La.)
Moose elm
Oo-hoosk-ah—"It slips" (Indians, N. Y.)
Indian elm
Sweet elm
Gray elm (trade)

Description

The elms are quite similar in wood structure and characteristics. They belong to the ring-porous group of hardwoods. In general, the heartwood varies from a light brown (American elm) to a reddish-brown (red elm). The sapwood is lighter and varies in width in the different species. When cut tangentially, the wood displays a pleasing figure, due primarily to the arrangement of the pores. Quartering has little effect in bringing out figure, since the wood rays are small and inconspicuous.

The wood of all the elms is heavy (rock elm being the heaviest and white elm the lightest). It is hard, strong, and tough. The relative strength values and properties of the various species are shown in Table 2.

Elm is considered one of our best bending woods. It also veneers well, takes glue, and has good nail holding qualities. The elms are slightly below hickory in mechanical properties. They have a tendency to warp and twist in drying, but proper handling and seasoning methods counteract this danger.

Elm takes a good polish, can be stained satisfactorily, and shrinks moderately in drying. All the elms are tough and do not split easily, with the exception of slippery elm. They have remarkable shock-resisting ability. Frequently rock elm can be substituted for hickory.

Elm is a fairly durable wood, but is less resistant to decay than some other hardwoods, such as white oak. American elm is probably the most resistant of all the elms. Preservative treatment is recommended for elm where it is to be used in exposed locations.

Uses

Elm has always been a decided favorite where shock-resisting properties are required, particularly for vehicle parts. Its use for binding purposes in slack cooperage and container use is most important. Large quantities are consumed in furniture manufacture. In most cases the various species of elm are used indiscriminately. The following list suggests a few of the most important uses for elm:

Vehicle industry
spokes, rims, body parts, etc.

Slack cooperage
hoops, staves, heading, etc.

Furniture
  curved backs, arms, legs, panels, dowels, etc.
Boxes and crates
Containers
  veneer boxes and specialty boxes
Woodenware
  pails, buckets, stepladders, wood pins, etc.
Agricultural implements
  handles, frames, hoppers, etc.
Veneers
  baskets, paneling, etc.

Classifications

Attention is called to two sets of grading rules for the grading of elm lumber, as follows:

Rock (or Cork) Elm, Hickory, and Pecan (Additional species of elm would grade under these rules, except American elm)

Basswood, Soft Elm (American Elm), Soft Maple, and Buckeye

These rules are issued by the National Hardwood Lumber Association.

(See general list of Associations for addresses.)

Types and Sizes

The following grades and sizes represent elm lumber which is most commonly cut and consumed by manufacturers and fabricators. It is available either air-dried or kiln-dried, and is carried in stock by representative mills in producing regions:

TABLE 52

FAS	4/4	6/4	8/4	
No. 1 Com. and Select	4/4	5/4	6/4	8/4
No. 2 Common	4/4	5/4	6/4	8/4
No. 3 Common	4/4	5/4		
Log Run	4/4	5/4	6/4	8/4

Unit Packages

Elm is usually sold on a standard grade basis. This is due to the wide range in value between the better grades. The lumber is measured on a board feet content basis.

Shipping Weights

Shipping weights for elm lumber are as follows:

TABLE 53

ELM, AMERICAN
(*Ulmus Americana*)

Weight per Cubic Foot: Green, 54; Air-dry (12% MC), 35 — Weights per Thousand Feet Surface Measure

(*Courtesy of Hardwood Manufacturers Institute*)

Thickness Inches (Actual)	*Green Weight (Note)*	*Per Cent of Moisture Content*					
		10%	12%	14%	16%	18%	20%
3/8	1687	1084	1094	1105	1116	1127	1138
13/32	1828	1174	1186	1197	1209	1221	1232
1/2	2250	1445	1459	1474	1488	1502	1517
17/32	2390	1535	1550	1566	1581	1596	1612
5/8	2812	1806	1824	1842	1860	1878	1896
11/16	3093	1987	2006	2026	2046	2066	2086
3/4	3374	2167	2189	2210	2232	2254	2275
13/16	3656	2348	2371	2395	2418	2441	2465
4/4	4500	2888	2917	2946	2975	3005	3035
17/16	4780	3070	3101	3131	3162	3193	3223
19/16	5343	3431	3466	3500	3534	3568	3602

NOTE: Green weights shown herein are predicated on the moisture content of the tree when felled. To calculate weights at other moisture content see Index—Moisture Content.

TABLE 54

ELM, ROCK

(*Ulmus racemosa*)

Weight per Cubic Foot: Green, 53; Air-dry (12% MC), 44 Weights per Thousand Feet Surface Measure

(*Courtesy of Hardwood Manufacturers Institute*)

Thickness Inches (Actual)	*Green Weight (Note)*	*Per Cent of Moisture Content*					
		10%	12%	14%	16%	18%	20%
3/8	1656	1361	1375	1390	1403	1417	1432
13/32	1794	1474	1490	1505	1520	1535	1551
1/2	2208	1814	1834	1853	1870	1890	1909
17/32	2346	1928	1948	1969	1987	2008	2028
5/8	2760	2268	2292	2316	2338	2362	2386
11/16	3036	2495	2521	2548	2572	2598	2625
3/4	3312	2722	2750	2779	2806	2834	2863
13/16	3588	2948	2980	3011	3039	3071	3102
4/4	4417	3630	3667	3704	3741	3778	3816
17/16	4692	3856	3896	3937	3975	4015	4056
19/16	5244	4309	4355	4400	4442	4488	4533

NOTE: Green weights shown herein are predicated on the moisture content of the tree when felled.

To calculate weights at other moisture content see Index—Moisture Content.

TABLE 55

ELM, SLIPPERY

(*Ulmus fulva*)

Weight per Cubic Foot: Green, 56; Air-dry (12% MC), 37 Weights per Thousand Feet Surface Measure

(*Courtesy of Hardwood Manufacturers Institute*)

Thickness Inches (Actual)	*Green Weight (Note)*	*Per Cent of Moisture Content*					
		10%	12%	14%	16%	18%	20%
3/8	1750	1145	1156	1168	1180	1192	1200
13/32	1895	1240	1252	1265	1278	1291	1300
1/2	2333	1526	1541	1557	1573	1589	1600
17/32	2479	1622	1637	1654	1671	1688	1700
5/8	2916	1908	1926	1946	1966	1986	2000
11/16	3208	2099	2119	2141	2163	2185	2200
3/4	3499	2290	2311	2335	2359	2383	2400
13/16	3791	2480	2504	2530	2556	2582	2600
4/4	4667	3052	3083	3114	3145	3176	3208
17/16	4957	3244	3274	3308	3342	3376	3400
19/16	5540	3625	3659	3697	3735	3773	3800

NOTE: Green weights shown herein are predicated on the moisture content of the tree when felled.

To calculate weights at other moisture content see Index—Moisture Content.

Ordering

It would be well to specify on orders the type of stock which is desired; i.e., "soft elm" or "rock elm." Many manufacturers prefer the somewhat softer-textured species, American elm; while for other purposes the tougher, rock elm is preferred.

For additional information see discussion on Ordering.

Caution

Since the elms have a tendency to warp and twist, precautions should be taken in kiln-drying and yard-seasoning so as to eliminate degrade from this cause as much as possible.

Mineral streaks, black streaks, or black spots are sometimes common in elm lumber.

There is no grade of "Selects" for rock elm, and special efforts should be made to ascertain the specific grade which will prove the most economical for the purpose in mind.

Special Service Requirements

Elm is a decided specialty wood, and its qualities make it particularly desirable for bending purposes, or where shock-resisting qualities are required.

Its attractive figure, finish, and ability to take stain and polish are especially notable.

It is not a construction wood, although sometimes used for cross ties and rough construction.

Elm, in addition, is a good handle wood.

Specifications

The following publications may be consulted for information regarding specifications for elm:

Standards and Specifications in the Wood-Using Industries—Bureau of Standards.
National Directory of Commodity Specifications—Bureau of Standards.

(See general Bibliography for publishers' addresses.)

Engineering Data

(See Table 2.)

Improvements

Considerable study has been given to the bending and gluing of elm.

Attention is also called to general discussion on this subject.

Associations

The following associations will be glad to give information regarding lumber and other stock cut from elm:

National Hardwood Lumber Association (Grading rules).
Northern Hemlock and Hardwood Association (General information and data).
Hardwood Manufacturers Institute (Production figures and prices).
National Lumber Manufacturers Association (General information).

(See general list of Associations for addresses.)

Publications

The following publications frequently carry trade items regarding elm, prices, and other data:

American Lumberman
American Woodworking Review
Gulf Coast Lumberman
Hardwood Buyers Guide
Hardwood Record
Industrial Woodworking
Lumber Trade Journal
Lumbermen's Clearing House Buyers' Guide
Memphis Lumberman and Southern Woodworker
Mississippi Valley Lumberman
National Lumberman
New York Lumber Trade Journal, The
Pennsylvania Lumberman
Southern Lumberman
Southern Lumber Journal
Veneers
Wood Workers Clearing House Journal
Wood Preserving News
Wood Working Industries

(See general list of Periodicals for publishers' addresses.)

Bibliography

The following books and articles may prove helpful to readers desiring further information:

Utilization of Elm—W. D. Brush.
"Elm"—Forest Service Leaflet, *American Woods Series.*
American Forest Trees—Henry H. Gibson.
Lumber and Its Uses—R. S. Kellogg.
Identification of Furniture Woods—Arthur Koehler.

(See general Bibliography for publishers' addresses.)

Abbreviations and Terminology

Sft. elm—soft, or gray, elm (American elm).

(See general list of Abbreviations and Glossary.)

THE GUMS

(Hardwoods)

TUPELO GUM[1]	BLACK GUM[1]
Nyssa aquatica	*Nyssa sylvatica*

(See also following chapter on Red Gum.)

ANNUAL PRODUCTION (1928)[2] ..... 316,544,000 bd. ft.
AVERAGE VALUE OF LUMBER CUT AT MILL PER M.B.F. (1928) $25.51
TIMBER STAND (1925):
TUPELO ..... 30,000,000,000 bd. ft.
BLACK GUM ..... 20,000,000,000 bd. ft.
SWAMP BLACK GUM, SOUR TUPELO ..... 10,000,000,000 bd, ft.

PRINCIPAL STATES PRODUCING CUT—IN ORDER OF IMPORTANCE:

Louisiana, South Carolina, Alabama, Mississippi, Texas, North Carolina.

Range of Species

Tupelo (Nyssa aquatica):

Coast region from southern Virginia to northern Florida, and through the Gulf States to Texas (Nueces River); northward through Arkansas, west Tennessee and Kentucky, southeastern Missouri to southern Illinois (lower Wabash River).

Black Gum (Nyssa sylvatica):

From Maine (Kennebec River) to northern Florida; west to southern Ontario, southern Michigan (up to Gratiot County), southern Missouri, Oklahoma, southwestern Arkansas (Rich Mountain, Hempstead County) and Texas (Brazos River).

Swamp Black Gum (Nyssa biflora):

Maryland (Montgomery County) to Florida (near Fort Ogden) and westward to western Louisiana and eastern Texas.

Sour Tupelo Gum (Nyssa ogeche):

From South Carolina (near coast and through the Altamaha region of eastern Georgia) to northern Florida (Clay County) and western Florida (Washington County).

Tupelo is generally found in wet locations, often in deep swamps and inundated areas. It is found growing as a close associate of cypress.

[1] This species is not to be confused with red gum or the other "gums" of this same genus. There are four gums of commercial importance, as follows: 1. Tupelo gum—Nyssa aquatica; 2. Black gum—Nyssa sylvatica; 3. Swamp black gum—Nyssa biflora; and 4. Sour Tupelo—Nyssa ogeche.

[2] Figures shown include data for tupelo gum, black gum, swamp black gum, and sour tupelo.

Black gum grows in all states east of the Mississippi River and in the southern part of its range, as far west as central Texas. Its site ranges from swamps to dry mountain sides.

Swamp black gum ranges to sites similar to tupelo gum, but does not require such extremely wet conditions as the latter species.

In the trade the term "tupelo" includes the tupelo gum, black gum, swamp black gum, and sour tupelo gum. Recently, some mills have started to separate black gum and

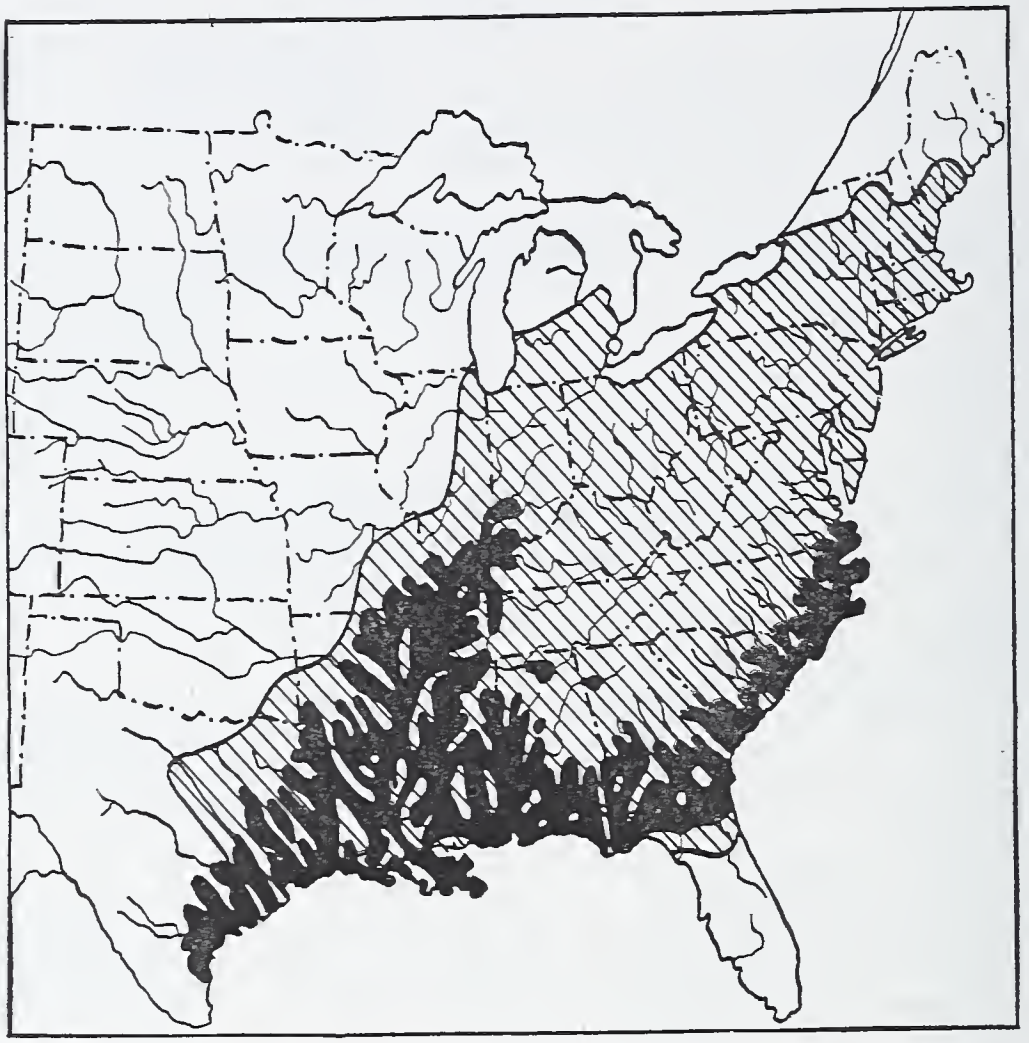


Illustration 80—General ranges of black and tupelo gums. Shaded area indicates commercial range of tupelo gum.

tupelo gum and sell them as separate woods. This is undoubtedly due to the fact that research has developed definite uses for these two species.

Tupelo gum and black gum are the most abundant and important of these gums, and are the largest.

Swamp black gum ranks next, while sour tupelo gum is of little importance commercially. Inasmuch as tupelo gum is the most important of all these species, discussions in this book pertain particularly to this wood.

Usual Names

Tupelo (Tupelo gum)
Black gum

Also Called

Tupelo Gum:

Large leaf tupelo (Ala., La., Tex., Fla.)
Tupelo gum (N. C., Ga., Ala., Miss., La., S. C., trade)
Sour gum (Ark., Mo., S. C.)
Bay poplar (Ala., Tenn., trade)
Swamp poplar (trade)
Hickory poplar (trade)
Chickasawatchie whitewood (trade)
Largeleaf white gum (trade)
Swampblack gum (lit.)
Pawpaw gum (Va.)
Gray gum (S. C., trade)
Yellow gum (N. C.)
Gum cottonwood
Swamp tupelo (S. C., La.)
Cotton gum (N. C., S. C., Fla., trade)
Tupelo (N. C., S. C., trade)
Wild olive tree (La.)
Olivier a grandes feuilles (La.)
Olivetree (Miss.)
White gum (N. C.)
Swamp gum (N. C.)
Bowl gum (N. C.)
Ladel gum (N. C.)
Big tupelo (lit.)
Bastard cottonwood (La.)

Black Gum:

Black gum (N. J., Pa., Del., Va., W. Va., N. C., S. C., Ga., Ala., Fla., Miss., La., Tex., Ill., Ind., trade)
Sour gum (Vt., Mass., R. I., N. Y., N. J., Pa., Del., Va., W. Va., S. C., Fla., Tex., Ohio, Ind., Ill.)
Tupelo (Mass., R. I., N. J., Del., S. C., Ala., Fla., Miss., Tex., Ill., Ohio, hort.)
Pepperidge (Vt., Mass., R. I., N. Y., N. J., S. C., Tenn., Mich., Ohio, Ontario)
Wild pear tree (Tenn.)
Yellow gumtree (Tenn.)
Gum (Md.)
Stinkwood (W. Va.)
Tupelo gum (Fla.)
Bowl gum

Swamp Black Gum:

Black gum (N. C.)
Lowland black gum (N. C.)
Lowland gum (N. C.)
Swamp black gum (N. C.)
Sour gum (N. C.)
Tupelo gum (N. C.)
Bowl gum (N. C.)
Water gum
Southern gum (Ala.)

Sour Tupelo Gum:

Sour tupelo gum (S. C., Fla.)
Ogeechee lime (S. C., Fla.)
Gopher plum (Fla.)
Tupelo
Wild limetree
Limetree
Ogechee plum
Lone tupelo
Sour tupelo gum

Description

The wood of all the "gums" is quite similar in structure. Both tupelo gum and black gum have wood which is diffuse-porous. It is fine-textured, does not splinter easily and is

rather easy to work. Often the grain is interlocked, which, upon quartering it, gives a ribbon effect. The wood is moderately strong and hard, but has a tendency to warp and twist in drying.

It is claimed that black gum is slightly harder, heavier, tougher, and more disposed to warp and twist than is tupelo. After the wood of these two species is cut into lumber it is very difficult to identify the species. Many inspectors admit their inability to absolutely identify it. However, if the separation of logs is made at the mill or in the region where the trees are cut, identification of the lumber is simplified.

The wood is almost white in color, with little variation between the heartwood and sapwood. The wood is susceptible to blue stain and is not resistant to decay.

Uses

Twenty-five years ago the commercial use of tupelo was practically unknown, and a great many mill operators in the South left the trees standing rather than cut them into lumber. As timber grew scarcer and stumpage prices higher, it became necessary to work out means and methods for the utilization of this species and for better ways of handling it. The United States Forest Service became interested in this project and made a thorough investigation of the subject. Today tupelo is an important lumber in the United States and is being used for a great many different purposes.

Some of its more important uses at present are for veneers, flooring, and to some extent for furniture. Interior trim and molding consume large amounts annually. For factory floors where heavy wear and abrasions occur, tupelo has been found to be very satisfactory. The following list indicates a few of the most important uses for tupelo:

Veneers and plywood
Veneer baskets and hampers
Flooring, platform decking
Interior trim
Molding and fixtures
Pulley blocks
Wood novelties
Laundry appliances
Boxes and crates
Toilet seats
Toys
Trunk manufacture
Crossing plank
Cooperage
Gun stocks
Broom handles
Musical instruments (frames and struts)
Body parts (frames)
Special boxes (coffee, tobacco, cigar)
Bobbin boxes
Automobile recoil blocks

(Tupelo and black gum can be used interchangeably with reference to their adaptability for various products. See discussion on description and properties of these two woods.)

Classifications

Tupelo and black gum lumber is graded according to *Standard Grading Rules for Sap Gum, Cottonwood, Black Gum, Tupelo, Magnolia, and Aspen,* as established by the National Hardwood Lumber Association.

(See general list of Associations for addresses.)

This association's inspectors do not make any distinction between black gum and tupelo. Note, however, that separate rules are given for *quartered black gum* (quartered tupelo is also graded under these rules).

Types and Sizes

The following grades and sizes represent tupelo and black gum lumber which is most commonly cut and consumed by manufacturers. It is available either air-dried or kiln-dried, and is carried in stock by representative mills in producing regions:

Tupelo:

TABLE 56

FAS, Qtd	4/4	5/4	6/4	
No. 1 Com. and Select	4/4	5/4	6/4	
FAS, Plain	4/4	5/4	6/4	8/4
No. 1 Common, Plain	5/8	4/4	6/4	
No. 2 Common, Plain	4/4	5/4		
No. 3 Common, Plain	4/4			

Black Gum:

TABLE 57

FAS, Qtd	4/4	5/4	8/4	
No. 1 Common and Sel., Qtd	4/4	5/4	8/4	
No. 2 Common, Qtd	4/4			
FAS Plain black gum	4/4	5/4		
No. 1 Com. and Sel. pl. bl. g	4/4	5/4	6/4	8/4
No. 2 Com. and Sel. pl. bl. g	4/4	5/4		

Unit Packages

Tupelo and black gum are sold on log run, mill run, or standard grade basis. The lumber is tallied on board feet basis, and tallied by actual board feet content tally, or export tally.

Shipping Weights

TABLE 58

GUM, TUPELO
(*Nyssa aquatica*)

Weight per Cubic Foot: Green, 56; Air-dry (12% MC), 35 Weights per Thousand Feet Surface Measure

(*Courtesy of Hardwood Manufacturers Institute*)

Thickness Inches (Actual)	*Green Weight (Note)*	*Per Cent of Moisture Content*					
		10%	12%	14%	16%	18%	20%
3/8	1750	1084	1094	1105	1116	1127	1138
13/32	1895	1174	1186	1197	1209	1221	1232
1/2	2333	1445	1459	1474	1488	1502	1517
17/32	2479	1535	1550	1566	1581	1596	1612
5/8	2916	1806	1824	1842	1860	1878	1896
11/16	3208	1987	2006	2026	2046	2066	2086
3/4	3499	2167	2189	2210	2232	2254	2275
13/16	3791	2348	2371	2395	2418	2441	2465
4/4	4667	2888	2917	2946	2975	3005	3035
17/16	4957	3070	3101	3131	3162	3193	3223
19/16	5540	3431	3466	3500	3534	3568	3602

NOTE: Green weights shown herein are predicated on the moisture content of the tree when felled.

To calculate weights at other moisture content see Index—Moisture Content.

TABLE 59

GUM, BLACK
(*Nyssa sylvatica*)

Weight per Cubic Foot: Green, 45; Air-dry (12% MC), 35 Weights per Thousand Feet Surface Measure

(*Courtesy of Hardwood Manufacturers Institute*)

Thickness Inches (Actual)	*Green Weight (Note)*	*Per Cent of Moisture Content*					
		10%	12%	14%	16%	18%	20%
3/8	1406	1084	1094	1105	1116	1127	1138
13/32	1524	1174	1186	1197	1209	1221	1232
1/2	1875	1445	1459	1474	1488	1502	1517
17/32	1992	1535	1550	1566	1581	1596	1612
5/8	2344	1806	1824	1842	1860	1878	1896
11/16	2578	1987	2006	2026	2046	2066	2086
3/4	2813	2167	2189	2210	2232	2254	2275
13/16	3047	2348	2371	2395	2418	2441	2465
4/4	3750	2888	2917	2946	2975	3005	3035
17/16	3985	3070	3101	3131	3162	3193	3223
19/16	4454	3431	3466	3500	3534	3568	3602

NOTE: Green weights shown herein are predicated on the moisture content of the tree when felled.

To calculate weights at other moisture content see Index—Moisture Content.

Ordering

Be sure to specify whether stock is to be quartered or plain-sawed. If a definite species is required, that is, tupelo gum or black gum, it would be advisable to specify in the order that "black gum will not be accepted," or vice versa. Purchases in this case should be made from mills specializing in either tupelo gum or black gum lumber.

Market quotations on lumber are given separately for black gum and tupelo gum.

Caution

(See general discussion on this subject.)

Special Service Requirements

Tupelo and black gum can be used successfully where higher priced woods are being used. For cheaper grades of fabricated products these two species are being used very satisfactorily.

The properties of tupelo and black gum make them especially suitable where hard wear, nonsplitting qualities, and ability to take finish are important, such as tough veneers, flooring, toys, as a base for enameling, etc. The wood of these two species has higher nail-holding ability. If the wood is to be employed in locations favorable to decay it should be treated before being used.

Specifications

The following publications may be consulted for information regarding specifications for tupelo and black gum:

Standards and Specifications in the Wood-Using Industries—Bureau of Standards.

National Directory of Commodity Specifications—Bureau of Standards.

(See general Bibliography for publishers' addresses.)

Engineering Data

(See Table 2.)

Improvements

Tupelo and black gum, up to within the last few years, had not been considered as species which were in favor with lumber manufacturers. The properties and possible uses for these two species had not been studied, and little was known regarding the wood. Drying and seasoning offered many difficulties and resulted in lumber that was badly warped, stained, and checked. In 1906 the Forest Products Laboratory of the United States Department of Agriculture investigated the matter of seasoning, and developed methods of drying and handling that revolutionized the use of tupelo. Other studies were made on black gum, and definite uses for this species were developed.

Manufacturers of tupelo and black gum today use extreme care in manufacture and seasoning, and have established these species as important commercial woods.

Associations

The following associations will be glad to give information regarding lumber and other stock cut from tupelo and black gum:

The National Hardwood Lumber Association (Grading rules).

Hardwood Manufacturers Institute (Production figures and prices).

National Lumber Manufacturers Association (General information, and data on uses).

Appalachian Hardwood Club (Information and data on uses).

Southern Cypress Manufacturers Association (Information on *tupelo*).

(See general list of Associations for addresses.)

Publications

The following publications frequently carry trade items regarding tupelo and black gum, prices, and other data:

American Lumberman
Gulf Coast Lumberman
Hardwood Buyers Guide
Hardwood Record
Industrial Woodworking
Lumber Trade Journal
Lumbermen's Clearing House Buyers' Guide
Memphis Lumberman and Southern Woodworker
Millwork
Mississippi Valley Lumberman
National Lumberman
New York Lumber Trade Journal, The
Southern Lumberman
Southern Lumber Journal
Veneers
Wood Working Industries

(See general list of Periodicals for publishers' addresses.)

Bibliography

The following books and articles may prove helpful to readers desiring further information:

"Tupelo"—Forest Service Leaflet, *American Wood Series.*

Distinguishing Characteristics of North American Gumwoods—G. B. Sudworth and C. D. Mell.

The Utilization of Tupelo—H. B. Holroyd.

Lumber and Its Uses—R. S. Kellogg.

American Forest Trees—Henry H. Gibson.

(See general Bibliography for publishers' addresses.)

Abbreviations and Terminology

Qtd. Bl. Gum—quartered black gum
Pl. Bl. Gum—plain black gum
Tup.—tupelo
T. Gum—tupelo gum

(See general list of Abbreviations and Glossary.)

RED GUM

(A Hardwood)

Liquidambar styraciflua

Annual Production (1928) ..... 967,756,000 bd. ft.
Average Value of Lumber Cut at Mill per M.B.F. (1928) $31.91
Timber Stand (1925) ..... 35,000,000,000 bd. ft.

Principal States Producing Cut—in Order of Importance (1928):

Louisiana, Mississippi, Arkansas, Texas, Alabama, South Carolina, Tennessee, Georgia, Florida.

Range of Species

From Connecticut to southeastern Missouri, Arkansas, and Oklahoma; south to Florida and Texas; occurring also in central and southern Mexico and Guatemala.

"Gum wood" or "red gum" is cut from the heartwood of the red gum tree. Commercially, the tree known as "red gum" belongs to an entirely different family than the others termed "gum" in the trade. According to botanical differentiation it is not related to tupelo gum, black gum, or sour gum.

Red gum is one of our most common and abundant hardwood species. Its rise to fame as a commercially important tree has been phenomenal. For years loggers cutting the more valuable species—cypress, ash, and white oak—left it standing in the woods. Mills experienced difficulty with it due to its tendency to warp and twist and stain during seasoning. Early in 1900 a study was made to develop drying schedules and methods of piling which would eliminate the bugaboo against this species. Excellent results were obtained, and today red gum represents one of our most valuable hardwood species.

Usual Names

The lumber cut from this tree is most frequently referred to as red gum. In England, and for general export use, it is sometimes termed "satin walnut" (heartwood) and "hazel pine" (sapwood).

Also called

Sweet gum (Mass., R. I., N. Y., N. J., Pa., Del., Va., W. Va., N. C., S. C., Ga., Ala., Miss., La., Tex., Ark., Ky., Tenn., Mo., Ill., Ind., Ohio, hort.)
Liquidambar (R. I., N. Y., N. J., Pa., La., Tex., Ohio, Ill.)
Red gum (Md., Va., Ky., Ala., Miss., Tex., La., trade)
Gum (Va., Ky., trade)
Gumtree (S. C., La.)
Bilsted (N. J.)
Star-leaved gum
Satin walnut (lumber markets)

Satinwood (Miss.)
American "magohany" (Miss.)
Hazelwood (trade)
Alligator wood (N. J., W. Va.)
Delta red gum (trade)
White gum
Opossum tree
Alligator-tree
Incense-tree
Copalm
Sap
Sapgum (trade)

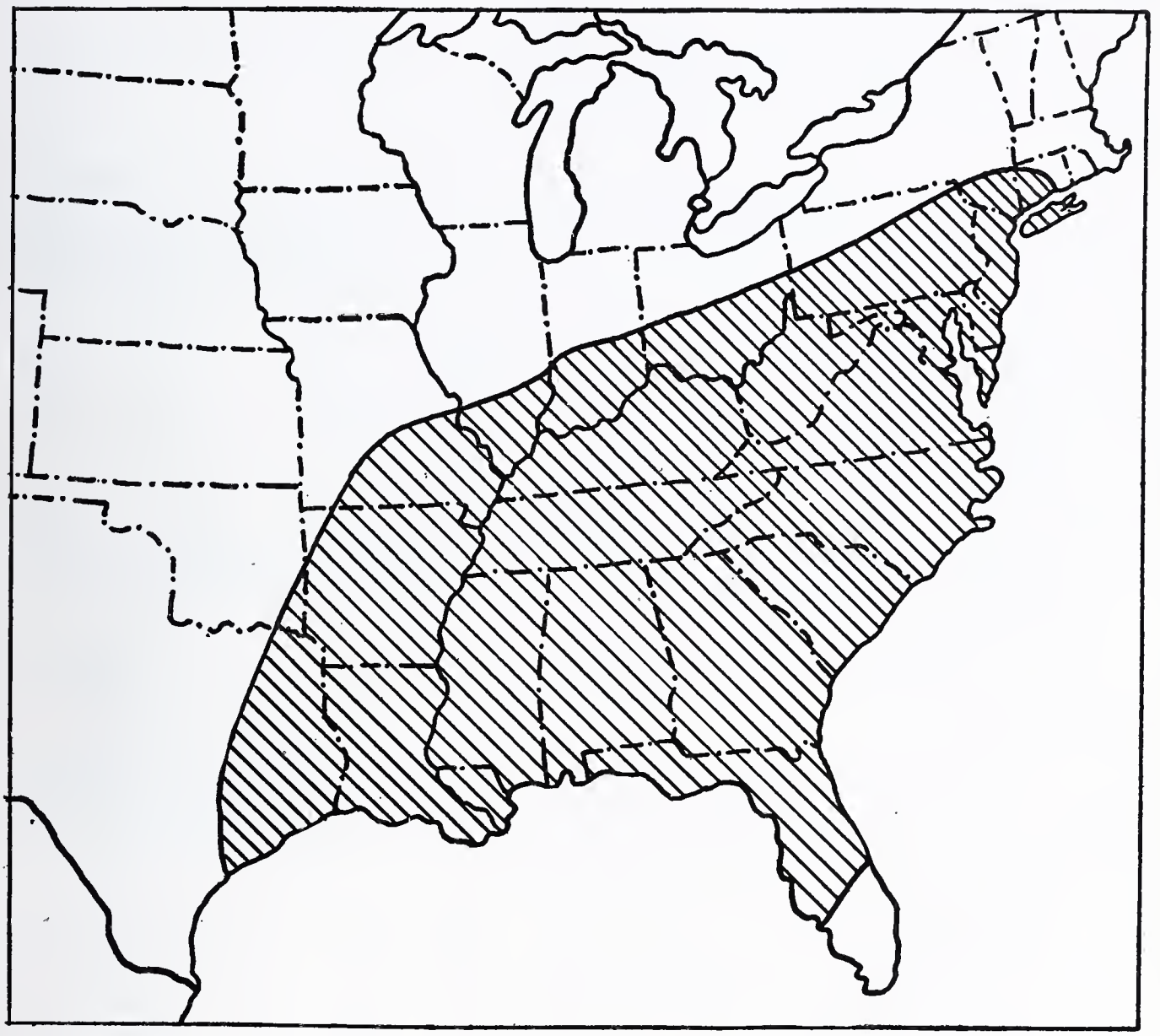


Illustration 31—General range of red gum.

Description

Red gum is moderately heavy and strong. It splits quite easily after kiln-drying and sometimes shows brashness. The sapwood ranges in color from white with a pink cast to creamy white. The sapwood is easily stained and develops a discouraging deep blue color. Quite often it is mistaken as a detriment. However, tests have shown that blue stain, unless decay has started, does not weaken the wood or injure it mechanically. The heartwood does not stain and ranges in color from a pinkish cast to a deep reddish-brown.

The wood is quite porous, with a tendency to develop interlocked grain, in certain

trees, that produces a beautiful ribbon stripe effect upon quartering. The wood of some trees has a rich, smoky, cloudy, shaded series of rings which, upon cutting, develop a unique figure, resembling that found in Circassian walnut. This figure ("figured red gum") is one of the most prized properties of red gum, and demands the best prices in the trade. Studies which have been made indicate that this freak of nature is developed by certain pigments lodged in the pores of the wood, probably due to site, soil conditions, etc., in which the tree grows.

The wood in general is fine-textured, produces a beautiful satiny finish, and is easily stained to resemble other woods. It veneers and glues well, and has good nail and screw holding qualities. It does not impart odor or taste.

Uses

The adaptability of red gum to a wide and diversified field of uses has resulted in making this species one of our most important woods. Its greatest use is for industrial products, but many millions of feet are used for planing mill products, such as panels, doors, trim, and molding. Below are listed a few of the more important uses for red gum:

Veneers and plywood
Interior finish
Furniture and fixtures
Boxes and crates
Automobile body frames
Veneer packages
Cooperage
Musical instruments
Toys and novelties

Classifications

Red gum is graded in accordance with The National Hardwood Lumber Association rules for this species, as follows (see general list of Associations for addresses):

Rules covering Plain Red Gum
Rules covering Quartered Red Gum
Rules covering Red Gum—Figured Wood

Types and Sizes

The following grades and sizes represent red gum lumber which is most commonly cut and consumed by manufacturers and fabricators. It is available either air-dried or kiln-dried, and is carried in stock by representative mills in producing regions:

Red Gum: TABLE 60

FAS, Qtd.—Figured	4/4	5/4				
FAS, Plain—Figured	4/4	5/4	6/4			
No. 1 Com. and Select	4/4	5/4				
FAS, Qtd.—Plain	4/4	5/4	6/4	8/4		
No. 1 Com. and Sel., Qtd	4/4	6/4	8/4			
FAS, Plain	5/8	4/4	5/4	6/4	8/4	
No. 1 Com. and Sel., Plain	5/8	4/4	5/4	6/4	8/4	
No. 2 Com., Plain	5/8	4/4				

Sap Gum: TABLE 61

FAS, Qtd	4/4	5/4	6/4	8/4	10/4	12/4
No. 1 Com. and Sel., Qtd	4/4	5/4	6/4	8/4	10/4	
No. 2 Com., Qtd	4/4	5/4				
Box boards, Plain	4/4	(13″–17″ wide)				
FAS, Plain	3/4	4/4	5/4	(13″ and wider)		
FAS, Plain	5/8	3/4	4/4	5/4	6/4	8/4
No. 1 Com. and Sel	5/8	3/4	4/4	5/4	6/4	8/4
No. 2 Com	5/8	3/4	4/4	5/4	6/4	8/4
No. 3 Com	5/8	4/4	5/4			

Unit Packages

Red gum lumber is generally sold on standard grade basis. It is measured on board foot basis and tallied by (1) actual board feet content, or (2) export tally.

Shipping Weights

Weights for red gum lumber are as follows:

TABLE 62

GUM, RED

(*Liquidambar styraciflua*)

Weight per Cubic Foot: Green, 50; Air-dry (12% MC), 34 Weights per Thousand Feet Surface Measure

(*Courtesy of Hardwood Manufacturers Institute*)

Thickness Inches (Actual)	*Green Weight (Note)*	*Per Cent of Moisture Content*					
		10%	12%	14%	16%	18%	20%
3/8	1562	1052	1062	1073	1084	1094	1105
13/32	1693	1140	1151	1162	1174	1186	1197
1/2	2083	1403	1416	1430	1445	1459	1474
17/32	2213	1491	1505	1520	1535	1550	1566
5/8	2604	1754	1770	1788	1806	1824	1842
11/16	2864	1929	1947	1967	1987	2006	2026
3/4	3125	2105	2124	2146	2167	2189	2210
13/16	3385	2280	2301	2324	2348	2371	2395
4/4	4167	2805	2833	2861	2890	2919	2948
17/16	4427	2982	3009	3040	3070	3101	3131
19/16	4948	3332	3363	3397	3431	3466	3500

NOTE: Green weights shown herein are predicated on the moisture content of the tree when felled.

To calculate weights at other moisture content see Index—Moisture Content.

Ordering

(See general instructions under this subject.)

Caution

The figure of red gum shows to best advantage in tangential-sawed lumber and rotary-cut veneer. Ribbon stripe is brought out in quarter-sawed stock.

The sapwood stains and is limited in FAS grades. For many purposes blue stain on sapwood is not detrimental, as it can be quite easily stained and finished. For natural finishes the heartwood is preferred.

Note particularly the restrictions in grading rules of "sound stain" and the amount of sapwood allowed in the respective grades.

Special Service Requirements

Red gum is an excellent species for use where the following properties are important:

An exceptional figure
As a substitute for other woods
A wood which veneers well
Good nail and screw holding ability
A wood which does not impart taste or color
A wood which finishes well
A wood which is easily worked

Specifications

The following publications may be consulted for information regarding specifications for red gum:

Standards and Specifications in the Wood-Using Industries—Bureau of Standards.
National Directory of Commodity Specifications—Bureau of Standards.

(See general Bibliography for publishers' addresses.)

Engineering Data

(See Table 2.)

Improvements

Continual efforts are being made by mills to eliminate excessive staining of sapwood and to improve drying methods so as to prevent warping, twist, and split in dry-kilned and seasoned stock.

For other information see general discussion on this subject.

Associations

The following associations will be glad to give information regarding lumber and other stock cut from red gum:

The National Hardwood Lumber Association (Grading rules).
National Lumber Manufacturers Association (General information).
Hardwood Manufacturers Institute (Production figures and prices).

(See general list of Associations for addresses.)

Publications

The following publications frequently carry trade items regarding red gum, prices, and other data:

American Lumberman
American Woodworking Review
Gulf Coast Lumberman
Hardwood Buyers Guide
Hardwood Record
Industrial Woodworking
Lumber Trade Journal
Lumbermen's Clearing House Buyers' Guide
Memphis Lumberman and Southern Woodworker
Millwork
Mississippi Valley Lumberman
National Retail Lumber Dealer
National Lumberman
New York Lumber Trade Journal, The
Southern Lumberman
Southern Lumber Journal
Veneers
Wood Workers Clearing House Journal
Wood Construction
Wood-Worker, The
Wood Working Industries

(See general list of Periodicals for publishers' addresses.)

Bibliography

The following books and articles may prove helpful to readers desiring further information:

Red Gum—A. K. Chittendon.
Distinguishing Characteristics of North American Gum Woods—Based on the Anatomy of Secondary Wood—George B. Sudworth and Clayton D. Nell.
American Forest Trees—Henry H. Gibson.
Lumber and Its Uses—R. S. Kellogg.
Identification of Furniture Woods, The—Arthur Koehler.

(See general Bibliography for publishers' addresses.)

Abbreviations and Terminology

Red gum is sometimes abbreviated in the trade as follows:
R. Gum—Red Gum
Qtd. R. Gum—Quartered Red Gum
Pl. Sp. Gum—Plain Sap Gum
Qtd. Sp. Gum—Quartered Sap Gum

(See general list of Abbreviations and Glossary.)

HACKBERRY[1]

(A Hardwood)

Celtis occidentalis

Annual Production (1927).....2,313,000 bd. ft.
Average Value of Lumber Cut at Mill per M.B.F. (1927).....$25.04
Timber Stand.....(No figures)

Principal States Producing Cut—in Order of Importance (1927):
Arkansas, Mississippi, Tennessee.

Range of Species

From New England to Virginia and westward to eastern North Dakota, Iowa, southwestern Missouri, and western Kansas. As formerly understood, the range of this species extended as far north as the St. Lawrence River, as far west as western Washington, Oregon, Nevada, and New Mexico, and southward into Florida, and to Missouri and eastern Texas.

Hackberry is of the same family as the elms. It is not found in pure stands, and often occurs in the forest as single or scattered trees. In the swamps of the south, however, occasional thickets are found. The tree varies in size; saw logs usually average 18 to 30 inches in diameter. The tree is unique because of its wide distribution over the entire United States and parts of Canada. It also has relatives in Europe and the Old World. Few mills report hackberry as a single cut, usually classing it as ash. Because of this reason the cut may far exceed that as shown above.

Usual Name

Hackberry

Also Called

Hackberry (N. H., Vt., R. I., N. Y., N. J., Del., Pa., N. C., W. Va., Mo., Ill., Ind., Wis., Iowa, Kansas, Mich., Minn., S. D., Ohio, trade)
Sugarberry (N. Y., Pa., Del., Minn.)
Nettle-tree (R. I., Mass., Del., Mich.)
Hoop-ash (Vt.)
One-berry (R. I.)
Hacktree (Minn.)
Bastard elm (N. J.)
False elm
Nigger-pill
Beaverwood

[1] There are approximately fourteen species and varieties of the hackberry family. They have a comparatively large range, but the species of commercial importance and most abundant cut is Celtis occidentalis. Another species—known as sugarberry (Celtis laevigata)—is often confused with it. No attempt is made to segregate the cut of these two species.

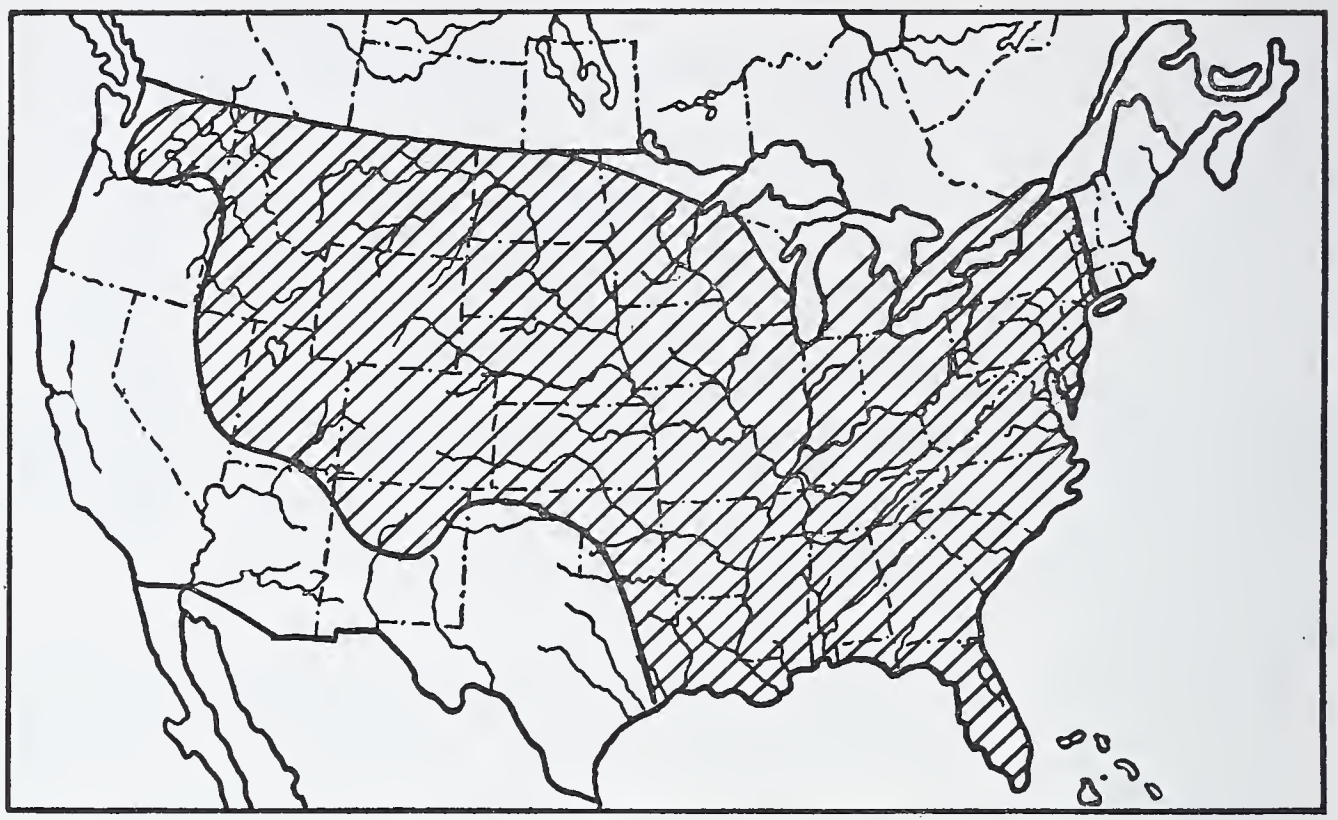


Illustration 32—General range of hackberry.

Description

Although frequently sold for ash, hackberry upon examination more closely resembles elm in its structure and properties. It is heavy but is only moderately hard and strong. It is ring-porous in structure. In general appearance, however, it can be easily mistaken at first glance for ash. In color, the heartwood resembles ash, but it is slightly yellower and varies from yellowish to greenish-gray. The sapwood is wide and sometimes is barely distinguishable from the heartwood. The sapwood has a tendency toward blue stain and is not resistant to decay. The wood does not impart odor or taste.

Uses

Hackberry is not considered an important commercial species, and its use is largely confined to the regions where it is cut. Competitive species which are produced in greater abundance limit its use. However, hackberry is used as a substitute wood for ash and elm. Hackberry is not used to a great extent in construction, and the bulk of it goes into specialty fabricated products. The following is a partial list of its important uses:

Cheaper grades of furniture
Boxes and crates
Cross ties
Handle stock
Vehicle parts
Slack cooperage
Handle stock (substitute for ash)
Rustic furniture
Containers

Classifications

Hackberry is graded according to *Standard Inspection for Ash, Beech, Birch, Hard (or Sugar) Maple, Hackberry, Red Alder, and Sycamore*, issued by the National Hardwood Lumber Association.

(See general list of Associations for addresses.)

Types and Sizes

The following grades and sizes represent lumber which is most commonly cut and consumed by manufacturers and fabricators. It is available either air-dried or kiln-dried, and carried in stock by representative mills in producing regions:

TABLE 63

FAS	4/4	6/4	8/4	10/4	12/4	16/4
No. 1 Com. and Sel	4/4	6/4	8/4	10/4	12/4	16/4
No. 2 Com	6/4	8/4	12/4	16/4		
No. 3 Com	4/4					

Unit Packages

Hackberry is usually sold on a mill run or log run basis. However, mills in the South that accumulate large amounts of this lumber separate it into grades and sell it on standard grade basis.

The lumber is tallied on actual board feet content basis, and only rarely on piece tally.

Shipping Weights

Shipping weights for hackberry lumber are as follows:

TABLE 64

HACKBERRY

(*Celtis occidentalis*)

Weight per Cubic Foot: Green, 50; Air-dry (12% MC), 37 — Weights per Thousand Feet Surface Measure

(*Courtesy of Hardwood Manufacturers Institute*)

Thickness Inches (Actual)	*Green Weight (Note)*	*Per Cent of Moisture Content*					
		10%	12%	14%	16%	18%	20%
3/8	1562	1145	1156	1168	1180	1192	1200
13/32	1693	1240	1252	1265	1278	1291	1300
1/2	2083	1526	1541	1557	1573	1589	1600
17/32	2213	1622	1637	1654	1671	1688	1700
5/8	2604	1908	1926	1946	1966	1986	2000
11/16	2864	2099	2119	2141	2163	2185	2200
3/4	3125	2290	2311	2335	2359	2383	2400
13/16	3385	2480	2504	2530	2556	2582	2600
4/4	4167	3052	3083	3114	3145	3176	3208
17/16	4427	3244	3274	3308	3342	3376	3400
19/16	4948	3625	3659	3697	3735	3773	3800

NOTE: Green weights shown herein are predicated on the moisture content of the tree when felled.

To calculate weights at other moisture content see Index—Moisture Content.

Ordering

(See general discussion on this subject.)

Caution

(See general discussion.)

Special Service Requirements

Hackberry is a low-priced hardwood species, and can be used as a substitute for ash and elm.

Specifications

The following publications may be consulted for information regarding specifications for hackberry:

Standards and Specifications in the Wood-Using Industries—Bureau of Standards.
National Directory of Commodity Specifications—Bureau of Standards.

(See general Bibliography for publishers' addresses.)

Engineering Data

(See Table 2.)

Improvements

(See general discussion on this subject.)

Associations

The following associations will be glad to give information regarding lumber and other stock cut from hackberry:

National Hardwood Lumber Association.
Hardwood Manufacturers Institute.
National Lumber Manufacturers Association.

(See general list of Associations for addresses.)

Publications

The following publications frequently carry trade items regarding hackberry, prices, and other data:

American Lumberman
Gulf Coast Lumberman
Hardwood Buyers Guide
Hardwood Record
Lumbermen's Clearing House Buyers' Guide
Memphis Lumberman and Southern Woodworker
Southern Lumberman
Southern Lumber Journal

(See general list of Periodicals for publishers' addresses.)

Bibliography

The following books and articles may prove helpful to readers desiring further information:

American Forest Trees—Henry H. Gibson.
Lumber and Its Uses—R. S. Kellogg.
Handbook of the Trees of the Northern United States and Canada, East of the Rocky Mountains—R. B. Hough.

(See general Bibliography for publishers' addresses.)

Abbreviations and Terminology

(See general list of Abbreviations and Glossary.)

PHILIPPINE HARDWOODS[1]

(Formerly designated as "Philippine Mahoganies")

TANGUILE
Shorea polysperma

RED LAUAAN
Shorea negrosensis

ALMON
Shorea eximia

(Accurate information on the timber stand, annual cut, etc., not available.)

Range of species

These species are confined to the Philippine Islands. Although known in the trade for years as "mahoganies," they are of an entirely different species, and the wood structure is not the same as that of true mahoganies. Tanguile and red lauaan, in particular, were referred to as mahoganies, and constituted the bulk of so-called "Philippine mahogany." Four other species that are quite similar to these species in structure, but which are different in color, and which previously were also known as "Philippine mahogany," are: the "white" lauaans, yakal, guijo, and apitong.

Usual Names

Tanguile
Red lauaan
Almon

Also Called

Tanguile: Bataan mahogany or Tanguile mahogany
Red Lauaan: Lauaan, Philippine Indoaco wood (trade name)
Almon: Sometimes called other names in native dialect; also white lauaan

Description

Tanguile:

The heartwood varies in color from pale brown to dark reddish-brown. The sapwood ranges from pale gray to reddish-brown. The wood is of medium hardness and is medium heavy. When quartered it produces a distinct ribbon stripe.

The grain is often wavy and "interlocked," thus accounting for the ribbon stripe. The wood is easily veneered, glues well, and is easy to work. The wood seasons easily and takes stain and polish well. It may warp if not carefully handled and piled.

Tanguile is in general slightly heavier, harder, stronger, and finer-grained than either red lauaan or almon.

[1] A recent order of the Federal Trade Commission prohibits the use of the word "mahogany" as applied to these woods. The trade now designates them as "Philippine hardwoods," or under special trade names.

Red Lauaan:

Red lauaan is quite similar to tanguile. The heartwood is light red to dark reddish-brown. The texture is somewhat coarser, and is cross-grained, producing ribbon stripe when quartered.

The wood is light to moderately heavy. It veneers well, glues well, and is easy to work. It is quite easily seasoned, with slight tendency to warping and season-checking.

Almon:

The heartwood is generally light red. The wood is moderately hard and moderately heavy, is somewhat cross-grained, and produces a beautiful ribbon stripe and silver grain when quartered and is very easy to work. The texture is generally coarse but the wood seasons well and easily. It is not very durable.

Uses

Tanguile, Red Lauaan, and Almon:

These species are used for the following purposes:

Furniture	Veneers
Interior finish	Airplane propellers
doors, panels, frames, and trim	Novelties
Office fixtures	Scientific instruments
Musical instruments	Flooring and parquet
Boat construction	Deck sheathing for boats
Cabinet work	Caskets
Picture frames	Pattern work

Classifications

Philippine hardwoods are now graded under the new rules of the National Hardwood Lumber Association. These rules have been adopted by the Philippine Lumber Export Association.

(See general list of Associations for addresses.)

There are also established rules for the grading of veneers.

Grading rules for these species have also been developed by the Department of the Interior, Bureau of Forestry, Manila, P. I.

Types and Sizes

Philippine hardwoods are available to American consumers in sizes similar to our own native hardwoods (random widths and lengths). The bulk of lumber produced for export is graded in this country after its arrival, with the exception of the stock from a few large producing mills who specialize in export trade and ship lumber already graded.

A large percentage of stock used for veneer manufacture has in the past been shipped in log or cant form, and made into veneer after its arrival here.

Philippine hardwood lumber is available in this country in lengths ranging from 2 ft. to 26 ft. or longer; for example, 2 ft., 4 ft., 6 ft., etc. Widths range from 3 in. to 24 in., with one inch intervals. Thicknesses range from $\frac{1}{2}''$, $\frac{5}{8}''$, $\frac{3}{4}$, $\frac{4}{4}$, $\frac{6}{4}$, $\frac{8}{4}$, etc., to $\frac{16}{4}$ and timbers.

Unit Packages

Philippine hardwoods in the United States are measured on actual board feet content basis, and are sold on grade basis.

Shipping Weights

The weights for these woods vary greatly. The following estimated weights will give a general indication of the approximate shipping weights, dry (partially seasoned).

TABLE 65

Tanguile	2800–3000 lbs. per 1,000 bd. ft.
Red lauaan	3200–3400 lbs. per 1,000 bd. ft.
Almon	2900–3000 lbs. per 1,000 bd. ft.

Ordering

Specify by its recognized name the particular Philippine hardwood species desired.

The Philippine Mahogany Association will be glad to assist in giving data and information in regard to purchasing.

(See general list of Associations for addresses.)

In every instance it is worth while to deal through recognized and established exporters or manufacturers of Philippine hardwoods.

Caution

Considerable difficulty has been experienced in the past in regard to interpretations of standard grading rules for Philippine hardwoods. Also a great deal of lumber has been found to be off-grade. Improvements have been gradually made so that the consumer will know what he receives and the exporter what he promises.

It would be well in purchasing to mention particularly "stock to be graded in accordance with National Hardwood Lumber Association grading rules."

Pinworm holes and insect holes are two of the most objectionable sources of defects encountered in Philippine hardwoods. They are exceedingly small and difficult to see with the naked eye. Scraping with wire brushes is found helpful in removing the dust from boards and exposing these small holes.

Kiln-drying will kill pinworms which are working in stock; tests have shown that they either die, or leave the stock during the process of seasoning.

Special Service Requirements

For many uses Philippine hardwoods can be substituted for true mahogany, particularly from an economical point of view. They are not as expensive, are obtainable in a wide variety of sizes, and all the species have figure (ribbon stripe), and are easily worked and fabricated. It is said, however, that Philippine hardwoods shrink and swell slightly more than true mahoganies, but compare quite favorably in strength values.

Practically all of the Philippine hardwoods are available in large sizes (widths and lengths).

Specifications

Standards and Specifications in the Wood-Using Industries—Bureau of Standards.
National Directory of Commodity Specifications—Bureau of Standards.

(See general Bibliography for publishers' addresses.)

Engineering Data

The following strength values of Philippine hardwoods will be of value in a general comparison of their mechanical properties. The information was prepared by the Philippine Bureau of Forestry:

TABLE 66

COMPARATIVE STRENGTH VALUES OF PHILIPPINE HARDWOODS

Air-dry Material	*Lbs. per Sq. In.*		
	TANGUILE	RED LAUAAN	ALMON
Modulus of rupture	10,000	Generally speaking lauaan is stronger than almon, but slightly weaker than tanguile	Strength properties are the weakest of these woods
Modulus of elasticity	1,690,000		
Fiber stress at elastic limit	4,9000		

Improvements

Due to the multitude of species of Philippine hardwoods, the study of the various mechanical and physical properties has progressed slowly. The more important ones, particularly those cut for export trade, have been the first to be considered and investigated.

The importance of these hardwood species is becoming more noticeable each year. It is probable that as more knowledge of these species is obtained, with reference to their possible uses and economies, they will compete keenly with native American hardwoods.

As previously mentioned, the question of grading rules and manufacture is being given more and more consideration and improvements are gradually being made. Exporters and manufacturers are constantly striving to meet the needs and requirements of American consumers. They are now using recognized names as applied to the various species of Philippine hardwoods, such as tanguile, red lauaan, almon, etc., instead of the name "Philippine mahogany" which was formerly used to cover all species.

Associations

The following associations will be glad to give information regarding lumber and other stock cut from the Philippine hardwoods:

National Hardwood Lumber Association.
Philippine Mahogany Association.
Philippine Lumber Export Association.

(See general list of Associations for addresses.)

Publications

The following publications frequently carry items regarding Philippine hardwoods, prices, etc.:

American Lumberman
Hardwood Buyers Guide
Lumber Trade Journal
Lumbermen's Clearing House Buyers' Guide
New York Lumber Trade Journal, The
Veneers
Wood Workers Clearing House Journal
Wood Working Industries

(See general list of Periodicals for publishers' addresses.)

Bibliography

The following books and articles may prove helpful to readers desiring further information:

Commerical Woods of the Philippines—Their Preparation and Uses—E. E. SCHNEIDER.

Lumber Industry of the Philippine Islands—JOHN A. FOWLER.

(See general Bibliography for publishers' addresses.)

Abbreviations and Terminology

Philippine Hardwoods are not usually abbreviated.
(See general list of Abbreviations and Glossary.)

THE HICKORIES[1]

(Hardwoods)

TRUE HICKORIES:

BIGLEAF HICKORY
Hickoria laciniosa
MOCKERNUT HICKORY
Hickoria alba
PIGNUT HICKORY
Hickoria glabra
SHAGBARK HICKORY
Hickoria ovata

PECAN HICKORIES:

BITTERNUT HICKORY
Hickoria cordiformis
NUTMEG HICKORY
Hickoria myristicæformis
WATER HICKORY
Hickoria aquatica
TRUE PECAN
Hickoria pecan

	True Hickories	*Pecan Hickories*
ANNUAL PRODUCTION (1928)	47,786,000 bd. ft.	2,985,000 bd. ft.
AVERAGE VALUE OF LUMBER CUT AT MILL PER M.B.F. (1928)	$38.83	$29.16

True and Pecan Hickories

TIMBER STAND (1925) ..... 16,000,000,000 bd. ft.

PRINCIPAL STATES PRODUCING CUT—IN ORDER OF IMPORTANCE (1928):

True Hickories	*Pecan Hickories*
Tennessee, West Virginia, Arkansas, Mississippi, Louisiana, Kentucky, Ohio, Indiana, Alabama, Florida, Missouri.	Louisiana.

Range of Species

Widely distributed over eastern part of the United States from Maine to Florida, Wisconsin to Oklahoma and Texas, north to Iowa, Kansas, Nebraska, and the Dakotas.

Iowa (Mississippi River in Muscatine and Clinton counties), through southern Illinois and Indiana, western Kentucky and Tennessee to central Alabama and Mississippi, through Missouri and Arkansas to southeastern Arkansas, Oklahoma, western Louisiana and central Texas, (Devil's River); Mexico. Considerably extended by cultivation.

[1] The hickories include two distinct groups—the common hickories, which are represented by approximately 30 species, and the true pecans. In the trade these species are not separated, but are sold under the general name "hickory."

There are five or six species of hickory which make up the commercial supply of hickory lumber. Pecan generally is marketed separately but sometimes is cut and sold along with true hickory.

The hickories have an extended range, and are found in every state east of the Mississippi River; also in several states west of the Mississippi River. The species have been heavily cut in the past and the timber stands have been greatly reduced.

Illustration 33—General range of the hickories. Double shaded area indicates range of commercial importance.

The bulk of the hickory timber now standing and from which the commercial supply of lumber is cut, is located in the lower Mississippi Valley region.

The hickories are found growing in a wide variety of sites and soils. They are a slow growing species, and obtain their best growth in rich, fertile soils. Some species demand moist growth conditions and are common inhabitants of river bottom land subject to overflow.

Usual Names

True Hickories:

Bigleaf hickory
Mockernut hickory
Pignut hickory
Shagbark hickory

Pecan Hickories:

Bitternut hickory
Nutmeg hickory
Water hickory
True pecan

Also Called

Bigleaf Hickory:

Big shellbark (Pa., W. Va., Ky., Ill., Kans.)
Bottom shellbark (Ill.)
Western shellbark, shellbark (Ky.)
Thick shellbark (S. C., Tenn., Ind.)
Thick shellbark hickory (N. C., Ark.)
King nut (Tenn.)
Ridge hickory (Mo.)
Shellbark hickory (Mo., Ontario)
Big shagbark (lit.)
Hickory (trade)
Bigleaf shagbark hickory

Mockernut Hickory:

Mockernut (Mass., R. I., N. Y., N. J., Del., Ala., Miss., La., Tex., Ark., Ill., Iowa, Kans., and hort.)
Whiteheart hickory (R. I., N. Y., Pa., Del., N. C., Tex., Ill., Iowa, Kan., Minn., Nebr., Ontario)
Bullnut (N. Y., Fla., Miss., Tex., Mo., Ohio, Ill.)
Black hickory (Tex., Miss., La., Mo.)
Big-bud, red hickory (Fla.)
Hickory (Ala., Tex., Pa., S. C., Nebr.)
Hardbark hickory (Ill.)
Common hickory (N. C.)
White hickory (Pa., S. C.)
Hickory nut (Ky.)
Big hickory nut (W. Va.)
Hog nut (Del.)
Hickory (trade)
Mockernut hickory

Pignut Hickory:

Pignut (N. H., Vt., Mass., Conn., R. I., N. Y., N. J., Pa., Del., W. Va., N. C., S. C., Fla., Ala., Miss., La., Tex., Ark., Ky., Mo., Ill., Ind., Ohio, Ontario, and hort.)
Bitternut
Black hickory (Miss., Ind.)
Broom hickory
Brown hickory (Del., Miss., Tenn.)
Hard-shell (W. Va.)
Red hickory (Del.)
Switch-bud hickory (Ala.)
White hickory (N. H.)
Hickory (trade)
Pignut hickory

Shagbark Hickory:

Shellbark hickory (Vt., N. H., Mass., R. I., N. Y., Pa., Del., Va., W. Va., N. C., S. C., Ga., Miss., La., Tex., Ark., Ky., Mo., Ind., Ill., Wis., Iowa, Kans., Nebr., Ohio, Ontario, Mich.)
Shagbark hickory (Vt., N. H., Mass., R. I., Conn., N. Y., N. J., Pa., Del., S. C., Ala., Miss., Tex., Ark., Mo., Ill., Wis., Mich., Minn., Kans., Nebr., Iowa)
Shellbark (R. I., N. Y., Pa., N. C.)
Upland hickory (Ill.)
Hickory (Vt., Ohio, trade)
Scalybark hickory (W. Va., Ky., S. C., Ala.)
Shagbark (R. I., Ohio)
Shellbark-tree (Del.)
White walnut (N. J.)
Walnut (Vt., N. Y.)
White hickory (Iowa, Ark.)
Shagbark walnut (Vt.)
Sweet walnut (Vt.)
Redheart hickory (Miss.)
"Tuscatine" (northern N. J.)

Pecan Hickories:

Pecan (Va., N. C., S. C., Tenn., Ga. (cult.), Ala., Miss., Tex., La., Ark., Mo., Ill., Ind., Iowa, Kans.)
Pecan nut (La.)
Pecanier (La.)
Pecan tree (La.)

Description

The woods of all the hickories resemble each other greatly in general appearance. The pecans are very similar in general appearance, but fall below the strength values and other mechanical properties as compared to the true hickories.

The hickories vary considerably in their properties, and it cannot be said that one hickory is as good as another, or that the species in one region is the same as that in another region.

Hickory belongs to the ring-porous type of hardwoods. A casual glance shows a similarity to ash. The heartwood is reddish-brown in color, while the sapwood is white.

The wood is strong, probably the strongest of all our commercial species of wood. It is very resistant to shock, exceptionally heavy and hard. Some woods, such as hard maple, Osage orange, and locust, sometimes exhibit greater strength than hickory, but lack the toughness and resilience that have made hickory a favorite. The strength and mechanical properties of hickory are shown in Table 2.

Pignut hickory is perhaps the favorite of all the hickories, due to its greater strength properties.

It was formerly thought that second growth hickory, producing a large amount of sapwood, was the most valuable for fabrication. The prejudice against the use of heartwood, or red hickory, has largely disappeared, chiefly as a result of the scarcity of second

growth timber. It has been ascertained through tests carried on by the Forest Products Laboratory that a reliable indication of the strength of hickory is its density. Many manufacturers of hickory products base their inspection of the lumber upon this principle, rather than on whether it is white or red in color.

Hickory is rather difficult to kiln-dry, although, with proper drying schedules, checking, warping, and twisting are reduced to a minimum. It shrinks considerably in drying.

The wood of the hickories is hard to work, but has a hard, smooth surface capable of taking an excellent polish, and offers unequaled wearing qualities. The wood is not durable in contact with the elements and is often susceptible to insect attack.

Uses

Hickory has always been a favorite where strength, toughness, and resilience are essential. It is a specialty wood, and is not generally used for building and construction purposes.

Its most important use today is for handle stock, vehicle spokes, rims, etc. It is estimated that over 50 per cent of the hickory produced is consumed in the vehicle industry. Hickory is the most favored wood for automobile wheel spokes.

Hickory is a favorite wood for handles for picks, sledges, hatchets, and hammers, consuming in this way approximately 25 per cent of the cut. The balance is used for specialty purposes, such as golf-club shafts, dowel pins, whipstock, meat skewers, athletic bars, etc.

Classifications

Hickory is graded in accordance with Grading Rules for Rock (or Cork) Elm, Hickory, and Pecan, issued by the National Hardwood Lumber Association.

(See general list of Associations for addresses.)

Attention is also called to Grading Rules for Hickory Dimension, issued by the same association.

Types and Sizes

Hickory often enters the market, not only in the form of rough lumber, but also in billets, small dimension, and flitches. Common sizes of hickory lumber are indicated below. Special requirements and sizes can be supplied by the producing mills.

The following grades and sizes represent hickory lumber which is most commonly cut and consumed by manufacturers and fabricators. It is available either air-dried or kiln-dried, and is carried in stock by representative mills in producing regions:

TABLE 67

FAS....4/4	6/4	8/4	10/4	12/4	16/4	
No. 1 Common....4/4	6/4	8/4				
No. 2 Common....4/4	5/4	6/4				
No. 3 Common....4/4						
Log run....4/4	5/4	6/4	8/4	10/4	12/4	16/4

Unit Packages

Hickory, due to its specialized uses, is sold in billets, by the cord, or by board feet contents. Also in the form of rough lumber, flitches, or small dimension.

Shipping Weights

Shipping weights for the various hickories are listed below:

TABLE 68

HICKORY, BIGLEAF SHAGBARK
(*Hicoria laciniosa*)

Weight per Cubic Foot: Green, 62; Air Dry (12% MC), 48 — Weights per Thousand Feet Surface Measure

(*Courtesy of Hardwood Manufacturers Institute*)

Thickness Inches (Actual)	*Green Weight (Note)*	*Per Cent of Moisture Content*					
		10%	12%	14%	16%	18%	20%
3/8	1938	1486	1500	1516	1530	1546	1561
13/32	2100	1609	1625	1642	1658	1674	1691
1/2	2584	1981	2000	2021	2040	2061	2082
17/32	2746	2105	2125	2147	2168	2190	2212
5/8	3230	2476	2500	2526	2550	2576	2602
11/16	3553	2724	2750	2779	2805	2834	2862
3/4	3876	2971	3000	3031	3060	3091	3122
13/16	4199	3219	3250	3284	3315	3349	3383
4/4	5166	3960	4000	4040	4080	4121	4162
17/16	5491	4207	4250	4294	4335	4379	4423
19/16	6137	4704	4750	4799	4845	4894	4944

NOTE: Green weights shown herein are predicated on the moisture content of the tree when felled. To calculate weights at other moisture content see Index—Moisture Content.

TABLE 69

HICKORY, MOCKERNUT
(*Hicoria alba*)

Weight per Cubic Foot: Green, 64; Air-dry (12% MC), 51 — Weights per Thousand Feet Surface Measure

(*Courtesy of Hardwood Manufacturers Institute*)

Thickness Inches (Actual)	*Green Weight (Note)*	*Per Cent of Moisture Content*					
		10%	12%	14%	16%	18%	20%
3/8	2000	1578	1594	1610	1626	1642	1658
13/32	2167	1710	1726	1745	1762	1778	1797
1/2	2667	2104	2125	2147	2168	2189	2211
17/32	2834	2236	2258	2281	2304	2326	2349
5/8	3334	2630	2656	2684	2710	2736	2764
11/16	3667	2893	2922	2952	2981	3010	3040
3/4	4001	3156	3187	3221	3252	3283	3317
13/16	4334	3419	3453	3489	3523	3557	3593
4/4	5333	4207	4250	4293	4336	4379	4423
17/16	5668	4471	4515	4563	4607	4651	4699
19/16	6335	4997	5046	5100	5149	5198	5252

NOTE: Green weights shown herein are predicated on the moisture content of the tree when felled. To calculate weights at other moisture content see Index—Moisture Content.

TABLE 70

HICKORY, PIGNUT

(*Hicoria glabra*)

Weight per Cubic Foot: Green, 64; Air-dry (12% MC), 53 Weights per Thousand Feet Surface Measure

(*Courtesy of Hardwood Manufactuers Institute*)

Thickness Inches (Actual)	*Green Weight (Note)*	*Per Cent of Moisture Content*					
		10%	12%	14%	16%	18%	20%
3/8	2000	1640	1656	1673	1690	1706	1724
13/32	2167	1777	1794	1812	1830	1849	1868
1/2	2667	2187	2208	2230	2253	2275	2299
17/32	2834	2324	2346	2370	2394	2417	2443
5/8	3334	2734	2760	2788	2816	2844	2874
11/16	3667	3007	3036	3067	3098	3128	3161
3/4	4001	3281	3312	3346	3379	3413	3449
13/16	4334	3554	3588	3624	3661	3697	3736
4/4	5333	4373	4417	4461	4506	4551	4597
17/16	5668	4648	4692	4740	4787	4835	4886
19/16	6335	5195	5244	5297	5350	5404	5461

NOTE: Green weights shown herein are predicated on the moisture content of the tree when felled.
To calculate weights at other moisture content see Index—Moisture Content.

TABLE 71

HICKORY, SHAGBARK

(*Hicoria ovata*)

Weight per Cubic Foot: Green, 64; Air-dry (12% MC), 51 Weights per Thousand Feet Surface Measure

(*Courtesy of Hardwood Manufacturers Institute*)

Thickness Inches (Actual)	*Green Weight (Note)*	*Per Cent of Moisture Content*					
		10%	12%	14%	16%	18%	20%
3/8	2000	1578	1594	1610	1626	1642	1658
13/32	2167	1710	1726	1745	1762	1778	1797
1/2	2667	2104	2125	2147	2168	2189	2211
17/32	2834	2236	2258	2281	2304	2326	2349
5/8	3334	2630	2656	2684	2710	2736	2764
11/16	3667	2893	2922	2952	2981	3010	3040
3/4	4001	3156	3187	3221	3252	3283	3317
13/16	4334	3419	3453	3489	3523	3557	3593
4/4	5333	4207	4250	4293	4336	4379	4423
17/16	5668	4471	4515	4563	4607	4651	4699
19/16	6335	4997	5046	5100	5149	5198	5252

NOTE: Green weights shown herein are predicated on the moisture content of the tree when felled.
To calculate weights at other moisture content see Index—Moisture Content.

TABLE 72

HICKORY, BITTERNUT

(*Hickoria cordiformis*)

Weight per Cubic Foot: Green, 63; Air-dry (12% MC), 46 Weights per Thousand Feet Surface Measure

(*Courtesy of Hardwood Manufacturers Institute*)

Thickness Inches (Actual)	*Green Weight (Note)*	*Per Cent of Moisture Content*					
		10%	12%	14%	16%	18%	20%
3/8	1969	1423	1438	1452	1466	1481	1495
13/32	2133	1542	1557	1573	1589	1604	1620
1/2	2626	1898	1917	1936	1955	1974	1994
17/32	2790	2016	2037	2057	2077	2098	2118
5/8	3282	2372	2396	2420	2444	2468	2492
11/16	3610	2609	2636	2662	2688	2715	2741
3/4	3938	2846	2875	2904	2933	2962	2990
13/16	4267	3084	3115	3146	3177	3208	3240
4/4	5250	3795	3833	3871	3910	3949	3988
17/16	5579	4032	4073	4114	4155	4196	4236
19/16	6236	4507	4552	4598	4644	4689	4735

NOTE: Green weights shown herein are predicated on the moisture content of the tree when felled.

To calculate weights at other moisture content see Index—Moisture Content.

TABLE 73

HICKORY, NUTMEG

(*Hicoria myristicæformis*)

Weight per Cubic Foot: Green, 60; Air-dry (12% MC), 42 Weights per Thousand Feet Surface Measure

(*Courtesy of Hardwood Manufacturers Institute*)

Thickness Inches (Actual)	*Green Weight (Note)*	*Per Cent of Moisture Content*					
		10%	12%	14%	16%	18%	20%
3/8	1876	1300	1313	1326	1339	1352	1366
13/32	2032	1408	1422	1437	1451	1465	1479
1/2	2501	1733	1750	1768	1786	1803	1821
17/32	2657	1841	1860	1879	1897	1916	1935
5/8	3126	2166	2188	2210	2232	2254	2276
11/16	3439	2383	2407	2431	2455	2479	2504
3/4	3751	2599	2626	2652	2678	2705	2731
13/16	4064	2816	2844	2873	2902	2930	2959
4/4	5000	3465	3500	3535	3570	3606	3642
17/16	5314	3682	3720	3757	3794	3832	3869
19/16	5939	4115	4157	4199	4241	4283	4324

NOTE: Green weights shown herein are predicated on the moisture content of the tree when felled.

To calculate weights at other moisture content see Index—Moisture Content.

TABLE 74

HICKORY, WATER
(*Hicoria aquatica*)

Weight per Cubic Foot: Green, 68; Air-dry (12% MC), 43 Weights per Thousand Feet Surface Measure

(*Courtesy of Hardwood Manufacturers Institute*)

Thickness Inches (Actual)	*Green Weight (Note)*	*Per Cent of Moisture Content*					
		10%	12%	14%	16%	18%	20%
3/8	2125	1330	1344	1357	1370	1385	1398
13/32	2302	1440	1456	1470	1485	1500	1515
1/2	2834	1773	1792	1810	1827	1846	1864
17/32	3011	1884	1904	1923	1941	1962	1981
5/8	3542	2216	2240	2262	2284	2308	2330
11/16	3896	2438	2464	2488	2512	2539	2563
3/4	4250	2659	2688	2174	2741	2770	2796
13/16	4605	2881	2912	2941	2969	3000	3029
4/4	5667	3547	3583	3619	3655	3692	3729
17/16	6021	3767	3808	3845	3883	3924	3961
19/16	6730	4210	4256	4298	4340	4385	4427

NOTE: Green weights shown herein are predicated on the moisture content of the tree when felled.
To calculate weights at other moisture content see Index—Moisture Content.

TABLE 75

PECAN
(*Hicora pecan*)

Weight per Cubic Foot: Green, 61; Air-dry (12% MC), 47 Weights per Thousand Feet Surface Measure

(*Courtesy of Hardwood Manufacturers Institute*)

Thickness Inches (Actual)	*Green Weight (Note)*	*Per Cent of Moisture Content*					
		10%	12%	14%	16%	18%	20%
3/8	1906	1454	1469	1483	1499	1513	1529
13/32	2064	1576	1591	1607	1624	1639	1656
1/2	2541	1939	1958	1978	1998	2018	2038
17/32	2700	2060	2081	2101	2123	2144	2166
5/8	3176	2424	2448	2472	2498	2522	2548
11/16	3494	2666	2693	2719	2748	2774	2803
3/4	3811	2909	2938	2966	2998	3026	3058
13/16	4129	3151	3182	3214	3247	3279	3312
4/4	5083	3878	3917	3956	3996	4036	4076
17/16	5399	4121	4162	4202	4247	4287	4332
19/16	6034	4606	4651	4697	4746	4792	4841

NOTE: Green weights shown herein are predicated on the moisture content of the tree when felled.
To calculate weights at other moisture content see Index—Moisture Content.

Ordering

Due to the mixing of true hickories and pecan hickories, specifications should be shown in purchase order for true hickory only, unless the purpose intended permits the use of pecan.

There is no grade of "Selects" for hickory.

Often manufacturers prefer to buy their hickory requirements in the form of flitches for remanufacturing purposes at the plant. Economies may be effected in the use of hickory in the form of small dimension.

Caution

Frequently hickory lumber contains small red or brown spots known as "bird pecks" or "mineral streaks." These are said to be caused by insect attack. These holes are filled with an extremely hard substance and detract from the surface appearance of the wood.

Worm holes and other insect holes must be carefully watched for in incoming shipments.

Special grading rules have been developed which allow for a certain amount of these defects in various grades.

Special Service Requirements

Hickory is without a peer where strength, toughness, and resilience are required. It is a true specialty wood where these qualities are desired.

Hickory is hard on tools and is considered the most difficult wood for machine fabrication.

Specifications

The following publications may be consulted for information regarding specifications for hickory:

Standards and Specifications in the Wood-Using Industries—Bureau of Standards.
National Directory of Commodity Specifications—Bureau of Standards.

(See general Bibliography for publishers' addresses.)

Engineering Data

(See Table 2.)

Improvements

(See general discussion on this subject.)

Associations

The following associations will be glad to give information regarding lumber and other stock cut from hickory:

National Hardwood Lumber Association (Grading rules).
Hardwood Manufacturers Institute (Production figures and prices).
Hickory Handle Association (General information).
National Lumber Manufacturers Association (General information).
Appalachian Hardwood Club.

(See general list of Associations for addresses.)

Publications

The following publications frequently carry trade items regarding hickory, prices, and other data:

American Lumberman
Gulf Coast Lumberman
Hardwood Buyers Guide
Hardwood Record
Lumber Trade Journal
Lumbermen's Clearing House Buyers' Guide
Memphis Lumberman and Southern Woodworker
Mississippi Valley Lumberman
New York Lumber Trade Journal, The
Southern Lumberman
Wood Workers Clearing House Journal
Wood Working Industries

(See general list of Periodicals for publishers' addresses.)

Bibliography

The following books and articles may prove helpful to readers desiring further information:

"Hickory"—Forest Service Leaflet, *American Wood Series.*
The Commercial Hickories—A. T. Boisen and J. A. Newlin.
Manufacture and Utilization of Hickory—C. F. Hatch.
"The Quality of Appalachian Hickory"—Benson H. Paul—*Southern Lumberman*, April 6, 1929.
Lumber and Its Uses—R. S. Kellogg.
American Forest Trees—Henry H. Gibson.

(See general Bibliography for publishers' addresses.)

Abbreviations and Terminology

(See general list of Abbreviations and Glossary.)

MAGNOLIA[1]

(A Hardwood)

Magnolia acuminata
Magnolia grandiflora

ANNUAL PRODUCTION (1928).....36,664,000 bd. ft.
AVERAGE VALUE OF LUMBER CUT AT MILL PER M.B.F. (1928).....$35.84
TIMBER STAND.....(No figures)

PRINCIPAL STATES PRODUCING CUT—IN ORDER OF IMPORTANCE:

Louisiana, Texas, Mississippi.

Range of Species

Magnolia acuminata (cucumber magnolia):

From western New York through southern Ontario and south to southern Ohio, Illinois and Indiana, and south in the Appalachian Mountains to northern Georgia, northern Alabama and northeastern, northwestern, and south-central Mississippi (Meridian), central Kentucky and Tennessee, northeastern, southern, and southwestern Arkansas, and eastern Oklahoma, and southwestern Missouri (Barry County).

Magnolia grandiflora (evergreen magnolia):

Coast region North Carolina (south of Cape Fear River) to Florida (Mosquito Inlet and Tampa Bay) and westward in the Gulf Coast region to Texas (Brazos River); through western Louisiana to southern Arkansas.

Note on Nomenclature.—Formerly designated as *Magnolia fœtida* (Linnæus) Sargent.

In all probability the cucumber magnolia is the principal species cut and produces the bulk of lumber.

The wood of the cucumber magnolia and the evergreen magnolia is similar, and for all purposes one species can be used just as well as the other. The history of magnolia is much like that of gum. Generally speaking, magnolia is a southern species, growing in close proximity to gum, tupelo, cypress, and others, as a companionate tree. Formerly there was only a small amount cut for timber, and magnolia trees were usually left standing during logging operations. The demand for more hardwood species led to study which developed that the properties of magnolia made it adaptable for many purposes. However, it is considered one of our minor hardwoods and cannot be considered an important commercial source of lumber.

[1] There are more than sixteen species and varieties represented in this family. Two species in particular are cut, and supply the bulk of lumber; (1) Magnolia acuminata (cucumber magnolia); and (2) Magnolia grandifolia (evergreen magnolia). In the trade magnolia is known by numerous local and regional names.

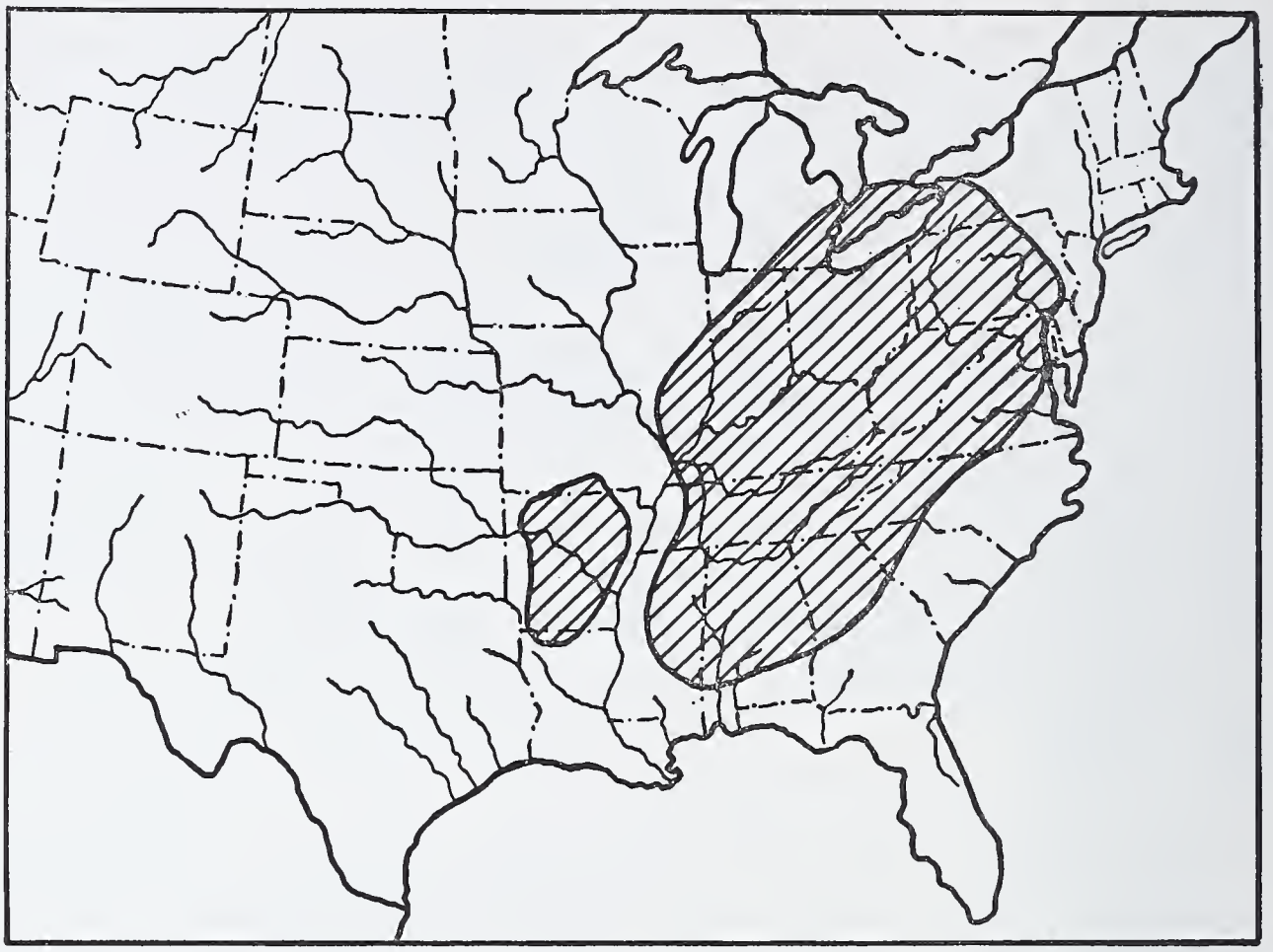


Illustration 34—General ranges of the cucumber and evergreen magnolias.

Usual Names

Cucumber magnolia
Evergreen magnolia

Also called

Cucumber Magnolia:

Cucumber-tree (R. I., Mass., N. Y., Pa., D. C., N. C., S. C., Ala., Miss., La., Ky., Ark., Va., W. Va., Ohio, Ind., Ill., hort.)
Mountain magnolia (Miss., Ky.)
Cucumber (Va., W. Va., N. C., Tenn., Ky., trade)
Black Linn (W. Va.)
Magnolia (Ark., trade)
Pointed-leaved magnolia (lit.)
Yellow Linn (Ky., W. Va.)
Cowcumber (Va., Tenn.)
Yellow poplar (trade)
Wauhoo
Elkwood
Blue magnolia

Evergreen Magnolia:

Magnolia (N. C., S. C., Ala., Fla., Miss., La., Tex., Ky., trade, in part)
Big laurel (N. C., S. C., Miss., La.)
Bull bay (Ala., Ga., Miss.)
Great laurel magnolia (Ala.)
Laurel-leaved magnolia
Large-flowered evergreen magnolia
Bat-tree
Laurel bay
Laurel (S. C.)
Southern magnolia (lit., hort.)

Description

Magnolia is similar in color to sapwood of poplar. The heartwood is creamy-white to light brownish, yellow; the sapwood is nearly white. The wood is often streaked, sometimes purplish or black. The wood belongs to the diffuse-porous hardwood species.

As a rule magnolia is harder, stiffer, and heavier than yellow poplar, which it much resembles. The wood is easily worked and finishes with a satiny luster. It takes stain well, is fairly easily dried, although it has a slight tendency to warp and twist.

Uses

Formerly, magnolia was used mostly in the regions where it was grown and cut. Its range of usefulness, however, has been extended, and a great amount is shipped to northern markets, particularly for automobile body manufacture for which it is highly prized. In the south, where it is a native, it is used for the same purposes as other competitive woods, such as poplar. Magnolia is also used for box and crate material, framing, millwork, core stock, in furniture fabrication, and panels. A comparatively small amount is cut into veneers for container purposes. Another use is for excelsior. Novelty articles, toys, pulleys, etc., are frequently made from magnolia.

Classifications

Magnolia is graded in accordance with *Standard Rules for Sap Gum, Cottonwood, Black Gum, Tupelo, Magnolia, Willow, and Aspen,* issued by the National Hardwood Lumber Association.

(See general list of Associations for addresses.)

Types and Sizes

The following grades and sizes represent magnolia lumber which is most commonly cut and consumed by manufacturers and fabricators. Magnolia lumber is available either air-dried or kiln-dried, and is carried in stock by representative mills in producing regions:

TABLE 76

FAS	4/4	5/4	6/4	8/4
No. 1 Common Select	4/4	5/4	6/4	8/4
No. 2 Common	4/4	5/4	6/4	8/4
No. 3 Common	4/4	5/4		

Unit Packages

Magnolia is a minor cut of the sawmills, and generally accumulates only in small amounts. For this reason it is usually sold on a log or mill run basis. Large mills, however,

are glad to quote figures on straight grades. The lumber is commonly measured on board foot basis.

Shipping Weights

Weights for magnolia (cucumber) are as follows:

TABLE 77

MAGNOLIA, CUCUMBER
(*Magnolia acuminata*)

Weight per Cubic Foot: Green, 49; Air-dry (12% MC), 34 — Weights per Thousand Feet Surface Measure

(*Courtesy of Hardwood Manufacturers Institute*)

Thickness Inches (Actual)	*Green Weight (Note)*	*Per Cent of Moisture Content*					
		10%	12%	14%	16%	18%	20%
3/8	1531	1052	1062	1073	1084	1094	1105
13/32	1659	1140	1151	1162	1174	1186	1197
1/2	2042	1403	1416	1430	1445	1459	1474
17/32	2169	1491	1505	1520	1535	1550	1566
5/8	2552	1754	1770	1788	1806	1824	1842
11/16	2807	1929	1947	1967	1987	2006	2026
3/4	3062	2105	2124	2146	2167	2189	2210
13/16	3318	2280	2301	2324	2348	2371	2395
4/4	4083	2805	2833	2861	2890	2919	2948
17/16	4338	2982	3009	3040	3070	3101	3131
19/16	4849	3332	3363	3397	3431	3466	3500

NOTE: Green weights shown herein are predicated on the moisture content of the tree when felled. To calculate weights at other moisture content see Index—Moisture Content.

TABLE 78

MAGNOLIA, EVERGREEN
(*Magnolia grandiflora*)

Weight per Cubic Foot: Green, 62; Air-dry (12% MC), 35 — Weights per Thousand Feet Surface Measure

(*Courtesy of Hardwood Manufacturers Institute*)

Thickness Inches (Actual)	*Green Weight (Note)*	*Per Cent of Moisture Content*					
		10%	12%	14%	16%	18%	20%
3/8	1938	1084	1094	1105	1116	1127	1138
13/32	2100	1174	1186	1197	1209	1221	1232
1/2	2584	1445	1459	1474	1488	1502	1517
17/32	2746	1535	1550	1566	1581	1596	1612
5/8	3230	1806	1824	1842	1860	1878	1896
11/16	3553	1987	2006	2026	2046	2066	2086
3/4	3876	2167	2189	2210	2232	2254	2275
13/16	4199	2348	2371	2395	2418	2441	2465
4/4	5166	2888	2917	2946	2975	3005	3035
17/16	5491	3070	3101	3131	3162	3193	3223
19/16	6137	3431	3466	3500	3534	3568	3602

NOTE: Green weights shown herein are predicated on the moisture content of the tree when felled. To calculate weights at other moisture content see Index—Moisture Content.

(Evergreen magnolia is slightly heavier than cucumber magnolia.)

Ordering

(See discussion on this subject.)

Caution

(See discussion on this subject.)

Special Service Requirements

Because of the similarity of its properties, magnolia can be substituted satisfactorily for yellow poplar. This refers particularly to "poplar sap."

Specifications

The following publications may be consulted for information regarding specifications for magnolia:

Standards and Specifications in the Wood-Using Industries—Bureau of Standards.
National Directory of Commodity Specifications—Bureau of Standards.

(See general Bibliography for publishers' addresses.)

Engneering Data

(See Table 2.)

Improvements

(See general discussion on this subject.)

Associations

The following associations will be glad to give information regarding lumber and other stock cut from magnolia:

National Hardwood Lumber Association.
Hardwood Manufacturers Institute.
National Lumber Manufacturers Association.

(See general list of Associations for addresses.)

Publications

The following publications frequently carry trade items regarding magnolia, prices, and other data:

American Lumberman
Gulf Coast Lumberman
Hardwood Buyers Guide
Hardwood Record
Memphis Lumberman and Southern Woodworkers
New York Lumber Trade Journal, The
Southern Lumberman
Southern Lumber Journal

(See general list of Periodicals for publishers' addresses.)

Bibliography

The following books and articles may prove helpful to readers desiring further information.

American Forest Trees—Henry H. Gibson.
Lumber and Its Uses—R. S. Kellogg.
Handbook of the Trees of the Northern United States and Canada, East of the Rocky Mountains—R. B. Hough.

(See general Bibliography for publishers' addresses.)

Abbreviations and Terminology

Mag.—magnolia.

(See general list of Abbreviations and Glossary.)

THE SO-CALLED MAHOGANIES

There are some sixty species that have been or are now being sold on the market under the name of "mahogany." Some of these belong to entirely different families and species, but often are very similar in appearance; in fact, a few are so closely related botanically that a most careful examination is required to distinguish the variations in wood structure. Of unique distinction in this category is African mahogany, which can be considered on a parity with true mahogany in commercial importance and merit. On the other hand, many of the so-called mahoganies have almost no characteristics that justify the use of the name "mahogany."

Practically all of these species are found in tropical or semi-tropical regions, and their logs and lumber are exported to this country for a multitude of specialized uses.

Only one species of "true" mahogany is found in the United States (in Florida), but it has a very small range and is not considered commercially important. The bulk of the supply of lumber of the true mahoganies is obtained from the West Indies and Central America.

The following table is arranged to indicate the nomenclature and botanical names of a few of the most important species of the so-called mahoganies.

TABLE 79

SPECIES COMMONLY CALLED "MAHOGANIES" [1]

Common Name	*Botanical Name*	*Also Called*
African mahogany	Khaya (various sub-species)	Senegal, Benin, etc., mah.
Prima vera	Tabebuia donnell-smithii	White mahogany
Cedralas (a hardwood)	Cedrela odorata	Spanish cedar
Gaboon	Aucoumea klaincana	Okumie or Okoume
Colombian mahogany	Cariniana pyriformis	——
Crabwood	Carapa guianensis	——
Sapeli	Entandrophragma candolleri	Sapeli mahogany
Tanguile	Shorea polysperma	(Formerly called) Philippine mahogany
Lauaan (red)	Shorea negrosensis	(Formerly called) Philippine mahogany
Almon	Sporea exima	(Formerly called) Philippine mahogany
Indian mahogany	Cedrela toona	Toon

KHAYA [2]

Khaya senegalensis, etc.

Range

Confined to West Coast of Africa, and inland along a belt from 15 degrees north to 20 degrees south of the equator; and found occasionally in Uganda and Mozambique on the East Coast. Principal producing localities: Ivory Coast, Gold Coast, Nigeria.

[1] For additional data, nomenclature, and uses, refer to discussion on "True Mahogany," "Philippine Hardwoods," etc.

[2] Several species of Khaya are marketed as African mahogany, the most common of which are the species mentioned.

Usual Name

African mahogany.

Also called

Bassam mahogany
Assinee mahogany
Senegal mahogany
Cambia mahogany
Benin mahogany
} (Name indicates region from which mahogany is obtained.)

African mahogany (Khaya) is of far greater commercial importance than any other non-Swietenia species. The volume of log production in Central American mahogany and African mahogany is practically equal, indicating the extent of its acceptance.

The use of this wood is so widespread, and its merits are so evident, that its long standing claim to the name "mahogany" is above reproach. African mahogany is real mahogany in all but botanical classification, and its use implies no intent to deceive. True mahogany is not available in commercial quantities for many of the purposes to which African mahogany is put, because of the attractively figured character of the wood, and its easy availability in excellent widths and lengths, particularly in veneers, and many of the good qualities which are commonly associated with mahogany are more typical of African mahogany than of the Swietenia type.

Description

The wood is similar to true mahogany, but does not show such extremes of density and color. Ribbon stripe in quartered stock is very pronounced. The wood is usually reddish-brown, often with a slight purplish tinge. It is fairly easy to dry, and seasons comparably to true mahogany, in that there is scarcely any warping. The color of the wood darkens upon exposure to the air. Figured wood, in addition to the prevalent stripe figure, occasionally occurs in mottle, fiddle-back, etc.

Uses

Khaya is used for practically the same purposes as true mahogany. Due to its excellent size, wider stock than is regularly available in Central American mahogany can be had in African mahogany lumber and veneers. It is in great demand by American fabricators. It is a favorite for panel stock, i.e., veneers, as it is the only mahogany in which figured stock is available in good quantities at a reasonable price. Even in drawer bottoms, and other semi-concealed work, the ease with which this wood, in the form of veneer, can be made into panels and attractively finished, has caused a widespread increase in the use of the inexpensive grades of African mahogany veneer, to the exclusion of somewhat cheaper, but less tractable woods. This is principally due to the fact that the extreme size of African logs permits the elimination of heart defects, etc., before the veneer is manufactured, in spite of which exceptionally wide quartered veneer remains. It is also used in large quantities in lumber for cabinet and furniture manufacture, marine construction, fixtures and interior trim, pattern making, etc.

Classification

Khaya is graded according to National Hardwood Lumber Association rules for Mexican and African mahogany.

(See general list of Associations for addresses.)

Publications

The following publications frequently carry trade items regarding the so-called mahoganies, prices, and other data:

American Lumberman
Hardwood Buyers Guide
Hardwood Record
Lumber Trade Journal
New York Lumber Trade Journal, The

(See general list of Periodicals for publishers' addresses.)

Bibliography

For information on the so-called mahoganies refer to bibliography for "true mahogany."
The following publications will be of value, also, for additional data on Khaya:

A Manual of the Timbers of the World—Alexander Howard.
Principal Species of Wood—Their Characteristic Properties—Charles Henry Snow.
Timbers of Commerce—Herbert Stone.

(See general Bibliography for publishers' addresses.)

PRIMA VERA

Tabebuia donnell-smithii

Range

Western coast of Mexico and Central America; southward to Guatemala.

Usual Name

Prima Vera, or white mahogany.

Also Called

Jenicero, or genesero (incorrectly).

Description

The wood is creamy-white to pale yellowish-brown. It is moderately heavy and hard and is easily worked. The grain produces ribbon stripe upon quartering. The color of this wood renders it easily distinguishable from other mahoganies. It is not plentiful and is more expensive than most mahoganies; therefore, no danger of substitution exists. "White mahogany" is now usually known by its proper name "Prima vera."

Uses

Similar to those for true mahogany; principally used in veneers.

CEDRALAS

(A Hardwood)

(*Spanish cedar*)

Cedrela odorata

There are several other varieties of this species which are cut and sold as "mahogany" in the trade, as follows:

Brazilian cedar—Cedrela braziliensis
Toon—Cedrela toona, or Toona ciliata

Usual Name

Spanish cedar

Also Called

Cigar-box cedar
Brazilian cedar ("cedro")
Indian mahogany—toon

Description

Spanish and Brazilian cedar, because of their general resemblance to the lighter colored, true mahoganies, are sometimes confused. Upon close examination it will be found that the odor of cedralas is distinctive; there is often a very apparent oily or gummy content visible on lumber and veneers, weighs less, and has a different color. Spanish cedar is in reality a hardwood, although called cedar (a softwood). It is light in weight, soft, and easy to work. Due to its fragrance it is much in demand for cigar boxes. The grain of the wood is not "interlocked" as much as true mahogany. The wood is very durable.

Uses

The principal use for this wood is for specialty purposes, such as cigar boxes, veneer, and cabinet work. It is also used for interior trim, in boat construction, novelties, etc. In the regions of its growth it is highly prized for rough construction work in the form of timbers; also for furniture and carpentry work.

Bibliography

For further information on Cedralas or Spanish cedar, consult bibliography for "true mahogany."

GABOON

Aucoumea klaincana

Range

This species is confined to Gaboon, the French Congo, and adjacent territory in Africa.

Usual Name

Gaboon

Also Called

Okume
Okoumie
African cedar
Gaboon mahogany

Description

This is another species which belongs to an entirely different family than true mahogany. The wood is lighter in color and is softer than mahogany. It varies from pinkish-brown to pale flesh color, with a tinge of lavender. After being finished the wood takes on a lustrous or satiny appearance. Much of this wood has an unfortunate characteristic of dulling saws. The grain runs straighter than mahogany, although a faint figured stripe is produced when quartered. The wood does not impart odor or taste. It is of plainer character than true African mahogany and more difficult to finish.

Uses

Gaboon is used as a cheap substitute for practically the same purposes as true mahogany, such as cabinet work, interior trim, etc. Large quantities are used in Germany and France in the form of veneers for cheap imitation mahogany panels.

Bibliography

For further information on Gaboon, consult bibiliography for "true mahogany."

COLOMBIAN MAHOGANY

Cariniana pyriformis

Range

The growth of this species is confined to Colombia, South America.

Usual Name

Colombian mahogany

Also Called

Cariniana (Colombia)
Albarco (Colombia)

Description

This species belongs to an entirely different family than true mahogany. The name "Colombian" is used principally to designate the source of the wood. Generally speaking, it has almost the same weight and color as true mahogany, except for a slight purplish color. The wood is moderately heavy and is fairly strong. It has a rather pronounced "interlocked" grain.

Uses

Similar to true mahogany.

Bibliography

For further information on Colombian mahogany, consult bibliography for "true mahogany."

CRABWOOD

Carapa guianensis

Range

Crabwood grows in northern South America as far south as the Amazon Valley, although the exact limits of its geographical distribution are not known. It is a common timber tree of British Guiana.

Usual Name

Crabwood

Also Called

Para mahogany
Brazilian mahogany
Demerara mahogany
British Guiana mahogany
Andiroba (South America)

Description

The wood is reddish-brown in color, with a tendency to a plain brown tinge. It varies in quality but, generally speaking, it is moderately heavy and hard, and is quite similar to true mahogany. The grain is straighter than true mahogany; the wood is said to be more difficult to dry, due to its tendency to warp and twist. It is strong and tough for its weight.

Uses

Crabwood is used for interior trim, and for medium priced furniture and veneers. It is comparatively little used at present, owing to reasonable price of superior mahoganies.

Bibliography

For further information on crabwood, consult bibliography for "true mahogany."

SAPELI

Entandrophragma candolleri

Range

Countries bordering the Gulf of Guinea and the west coast of Nigeria, Africa

Usual Name

Sapeli

Also Called

African mahogany

Description

The wood is considerably heavier than Khaya and slightly stronger. It also has an "interlocked" grain similar to the true mahoganies. The wood usually does not impart odor or taste, although there is occasionally a slight odor similar to Spanish cedar. Principal characteristics are dark brown color and pronounced stripe figure when quarter-sawed or quarter-sliced for veneers.

Uses

It is used for purposes similar to those of Khaya and the true mahoganies, particularly for cabinet use, veneers, etc. Comparatively little used in lumber, except for special purposes.

Bibliography

For further information on sapeli, consult bibliography for "true mahoganies."

TRUE MAHOGANY[1]

(A Hardwood)

Swietenia mahagoni

Swietenia macrophylla

Range

Swietenia mahagani:

Florida, West Indies, Central and South America, and elevated parts of Mexico.

Swietenia macrophylla:

Along the eastern coast of tropical America from the State of Tabasco, Mexico; to Honduras, and possibly farther south (entire range not known).

NOTE.—There is probably no other wood which has been so variously named and about which so much confusion has existed as the mahoganies. The name "mahogany" is applied commercially to more than fifteen different species. Five species have been identified by botanists as true mahoganies, and of these two are of commercial importance: namely, *Swietenia mahagoni Jacq.* and *Swietenia macrophylla King.*

In addition to the true mahoganies there are several so-called mahoganies which are now carefully differentiated from the genuine. African mahogany, although botanically different from Swietenia mahogany, is a thoroughly reputable commercial mahogany, equally or better suited for certain purposes. (See discussion of African Mahogany.) Some of these so-called mahoganies bear little more than a general resemblance to true mahogany in their structure, although skillful finishing may make them very much like it in outward appearance.

The woods more or less closely resembling mahogany, and at times confused with it, are: Spanish cedar, lauaan, bataan and tanguile (formerly called "Philippine mahogany"); padauk, an East Indian wood; and gaboon, sometimes known as "Liberville mahogany." (See chapter on So-called Mahoganies.)

True mahogany is a tropical tree, not occurring in pure stands, reaching great height and size. All genuine mahogany lumber and veneers, regardless of origin, are divided into two classes with reference to the surface appearance. These classes are plain and figured. By figure is meant the effect that is produced by the interlocking and interlacing of the wood fibers. Plain mahogany has no surface markings except those produced by the growth of the tree. Figure in mahogany is often spoken of as "stripy figure," "broken stripe," "mottle," "raindrop," "fiddle-back," and "crotch."

Usual Names

The nomenclature at present employed for true mahogany depends to a great extent upon the country in which it is cut, or the port from which it is shipped. Most frequently it is referred to as:

Cuban mahogany
Honduras mahogany
Mexican mahogany, etc.

[1] Refers only to "true" mahogany. These two species, formerly considered as one species, produce the bulk of true mahogany lumber.

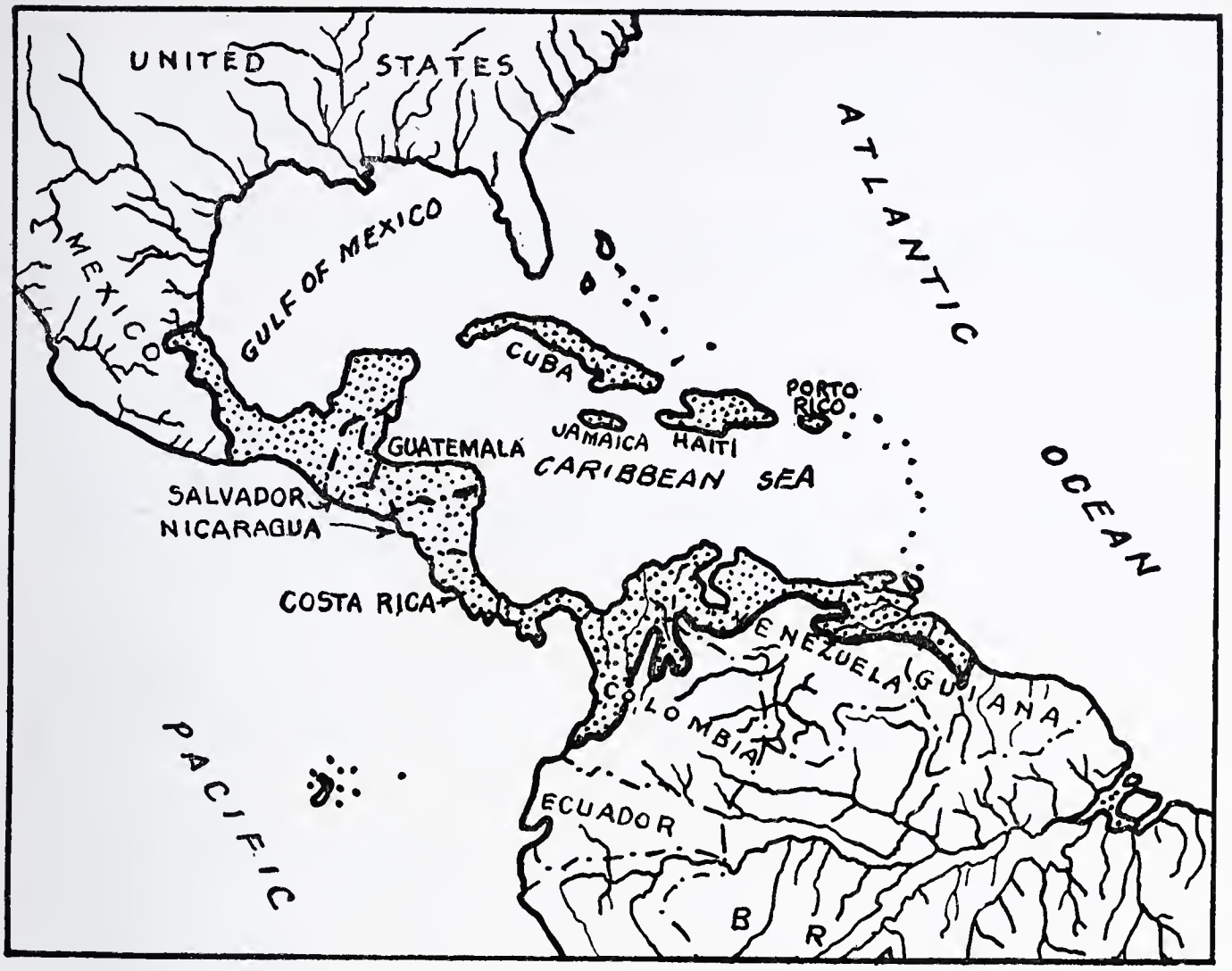


Illustration 35—General range of true mahogany.

Also Called

Cispata mahogany
Colombian mahogany
Cuban mahogany
Haitian mahogany
Honduras mahogany
Mexican mahogany
Nassau mahogany
Nicaraguan mahogany
Panaman mahogany
San Domingo mahogany
San Jago mahogany (Cuba)
Spanish American mahogany
Tabasco mahogany (Mexico)

Many trade names, local and foreign, are also applied to true mahogany. Honduras, Mexican, and Nicaraguan mahoganies are practically identical, and are all generally called "Mexican mahogany."

Description

The color, grain, and properties of true mahogany vary, depending upon the locality in which it is cut.

Generally speaking, mahogany is moderately strong and tough and quite uniform in structure. The wood seasons with little difficulty, there is scarcely any warping and checking, and when once seasoned the wood shrinks and swells very little. It holds its

shape exceptionally well. When polished it shows a beautiful natural finish and is well adapted for staining. It also veneers and glues well.

The weight of the wood varies. The color ranges from a light pinkish-brown to a dark reddish-brown, the shade deepening with exposure and age. Freshly sawed mahogany is light red or pinkish in color and is usually exposed to the light or "sunned" to deepen the color.

The following table indicates a few of the most striking variations in the "trade" varieties of true mahogany. Most of these characteristics depend upon soil and climatic conditions:

TABLE 80

Variations in Some of the Species of True Mahogany[1]

Mexican Mahogany	*Honduras Mahogany*	*Cuban Mahogany*
"Baywood" is the lightest of the true mahoganies; sapwood thick; color varies from light brown to deep red	Wood moderately soft and light in weight; generally straight-grained; usually free from knots; dark in color; grain varies	Hard, heavy, and slightly darker than Honduras mahogany; very strong and durable; large logs scarce

Uses

Mahogany is one of the most highly prized woods for furniture manufacture, marine work, and for interior trim. Fully 50 per cent is used for planing mill products, and includes such items as fixtures, showcases, doors, panels, trim, etc.

It is predominantly a furniture and cabinet wood; it is used to a great extent for the interior woodwork of banks, offices, hotels, and other structures requiring fine and artistic interior finish.

While some true mahogany is manufactured into veneers, the preponderance of mahogany veneer is from logs of African origin. Figured true mahogany is comparatively rare and expensive.

Classifications

The grading rules for mahoganies should be carefully examined, since the rules include not only true mahogany but the so-called mahoganies as well. They are issued by the National Hardwood Lumber Association and are grouped as follows:

Mexican mahogany and African mahogany (Khaya senegalensis)

(These grading rules are also used for Honduras, Nicaraguan, Guatemalan and other Central and South American mahoganies.)

Cuban and San Domingo mahogany

It will be noted that grading rules for mahogany are based upon trade names rather than on the species.

(See general list of Associations for addresses.)

Veneer is purchased from samples of individual flitches, or in accordance with specifications of size, figure, and soundness to meet the buyer's requirements.

Types and Sizes

A large bulk of the mahogany lumber used in this country at the present time is cut in the United States from logs which are imported. Mahogany lumber is available in any

[1] Florida mahogany, a true mahogany, is commercially nonexistent.

desired thickness and widths which are comparable to our native hardwoods. Generally speaking, mahogany can be purchased in sizes ranging from ½″ to 4″ in thickness, 3″ and wider in width, and from 3′ to 20′ in length. It is not difficult to secure any desired thickness on special order.

Unit Packages

As previously mentioned, mahogany is usually imported into this country in the form of round or hewn logs. (Nearly all Mexican mahogany is imported in round logs.) These are then sawed into lumber measuring the same as standard hardwood lumber. Mahogany lumber is measured on actual board feet content, except in thicknesses of less than one inch, when surface foot measure is used. Frequently, special stock is tallied on width and length piece tally, particularly for export. Very little mahogany is sold on log run grade basis, excepting Cuban mahogany.

Shipping Weights

The weights of the true mahoganies vary considerably. When dry, the lightest of the mahoganies (baywood) weighs approximately 2,800 lbs. per 1,000 board feet; Cuban mahogany, 3,700 lbs. per 1,000 board feet; Honduras and Mexican mahogany, 3,800 lbs. per 1,000 board feet; and Florida mahogany—the heaviest—approximately 4,400 lbs. per 1,000 board feet.

Naturally these weights will vary considerably and are only indicative of average species.

Ordering

Care should be exercised in specifying an order for the purchase of true mahogany. It is one of our most expensive and valuable woods.

In ordering, specify definitely the "type" name of the wood required (Honduras mahogany, Mexican, etc.). Also specify whether plain-sawed, quarter-sawed, or figured stock is desired; if figured, the type of figure. Particularly in the purchase of veneer, a small sample of desired type of figure will be helpful. Bear in mind that most figured mahogany is African mahogany.

Good care should be taken of stock after it is received by the purchaser, so as to eliminate possible degrade due to careless handling, storage, etc.

Caution

The claim that Mexican mahogany is generally of a much better grade than Central American mahoganies is not true in connection with the Mexican mahogany known as baywood (Shorea macrophylla), which usually sells for much less than the ordinary, heavier, darker-colored mahogany from regions farther north.

The dark, reddish-colored, true Mexican mahogany is fully equal to the Central American wood. No distinction is made in the trade with reference to the two species, or with regard to grades. Commercial Mexican mahogany may be of Nicaraguan, Central American, or Honduras origin.

Incoming shipments should be watched for evidence of pinworms or other insect damage.

Special Service Requirements

Mahogany is a most valuable wood for cabinetmaking, due to its lasting qualities, its color and grain, and its freedom from warping, shrinking, and checking.

Specifications

The following may be consulted for information on specifications:

Standards and Specifications in the Wood-Using Industries—Bureau of Standards.
National Directory of Commodity Specifications—Bureau of Standards.

(See general Bibliography for publishers' addresses.)

Engineering Data

Information regarding the mechanical properties of true mahogany, such as those compiled for our own native species, is not yet complete.

Associations

The following association will be glad to give information regarding lumber and other stock cut from mahogany:

National Hardwood Lumber Association.

(See general list of Associations for addresses.)

Publications

The following publications frequently carry trade items regarding prices, etc., of mahogany:

American Lumberman
American Woodworking Review
Hardwood Buyers Guide
Hardwood Record
Industrial Woodworking
Lumbermen's Clearing-House Buyers' Guide
Millwork
New York Lumber Trade Journal, The
Southern Lumberman
Veneers
West Coast Lumberman
Wood Working Industries

(See general list of Periodicals for publishers' addresses.)

Bibliography

The following books and articles may prove helpful to readers desiring further information:

True Mahogany—C. D. Mell.
The Identification of True Mahogany, Certain So-Called Mahoganies, and Some Common Substitutes—Arthur Koehler.
Mahogany, Antique and Modern—W. F. Payson.
Distinguishing Characteristics of Mahogany—Technical Note No. 162, Forest Products Laboratory.
The Identification of Furniture Woods—Arthur Koehler.

(See general Bibliography for publishers' addresses.)

Abbreviations and Terminology

Mah.—mahogany

(See general list of Abbreviations and Glossary.)

THE MAPLES[1]

(Hardwoods)

SUGAR (HARD) MAPLE
Acer saccharum

SILVER (SOFT) MAPLE
Acer saccharinum

BLACK (HARD) MAPLE[2]
Acer nigrum

RED (SOFT) MAPLE
Acer rubrum

ANNUAL PRODUCTION (1928) ..... 742,642,000 bd. ft.
AVERAGE VALUE OF LUMBER CUT AT MILL PER M.B.F. (1928) $36.31
TIMBER STAND (1925) ..... 40 to 50,000,000,000 bd. ft.

PRINCIPAL STATES PRODUCING CUT—IN ORDER OF IMPORTANCE (1928):

Michigan, Wisconsin, West Virginia, New York, Pennsylvania, Indiana, Vermont, Tennessee, Arkansas.

Range of Species

Sugar:

From southern Newfoundland and Nova Scotia to Lake of the Woods, Ontario, Minnesota, northeastern South Dakota, Iowa, eastern Kansas, central and southeastern Oklahoma, southwestern Arkansas, and eastern Louisiana; south to northern Georgia; west to eastern Nebraska, eastern Kansas, and eastern Texas.

Black:

From Quebec to New Hampshire, western Vermont, Massachusetts, northwestern Connecticut, ranging westward in northern and western New York, southern Ontario, Ohio, southern Michigan, Indiana, Illinois, and Iowa, to northeastern South Dakota, central-western Missouri, eastern Kansas; southward it extends through western Pennsylvania to West Virginia and Kentucky.

Silver:

From New Brunswick to western Florida; west to southern Ontario, through southern Michigan to southeastern South Dakota, eastern Nebraska, Kansas, eastern Oklahoma, southwestern Arkansas, and western Louisiana.

Red:

From Newfoundland to southern Florida and westward to western Wisconsin, northwestern Minnesota, southeastern Iowa, eastern Kansas, southwestern Oklahoma, southwestern Arkansas, and western Texas.

[1] In the trade maple is usually referred to as "hard" and "soft" maple. Some thirteen species grow in the United States, but only three or four are of commercial importance in the production of lumber.

[2] Black maple is practically the same as sugar maple and is used for the same purposes.

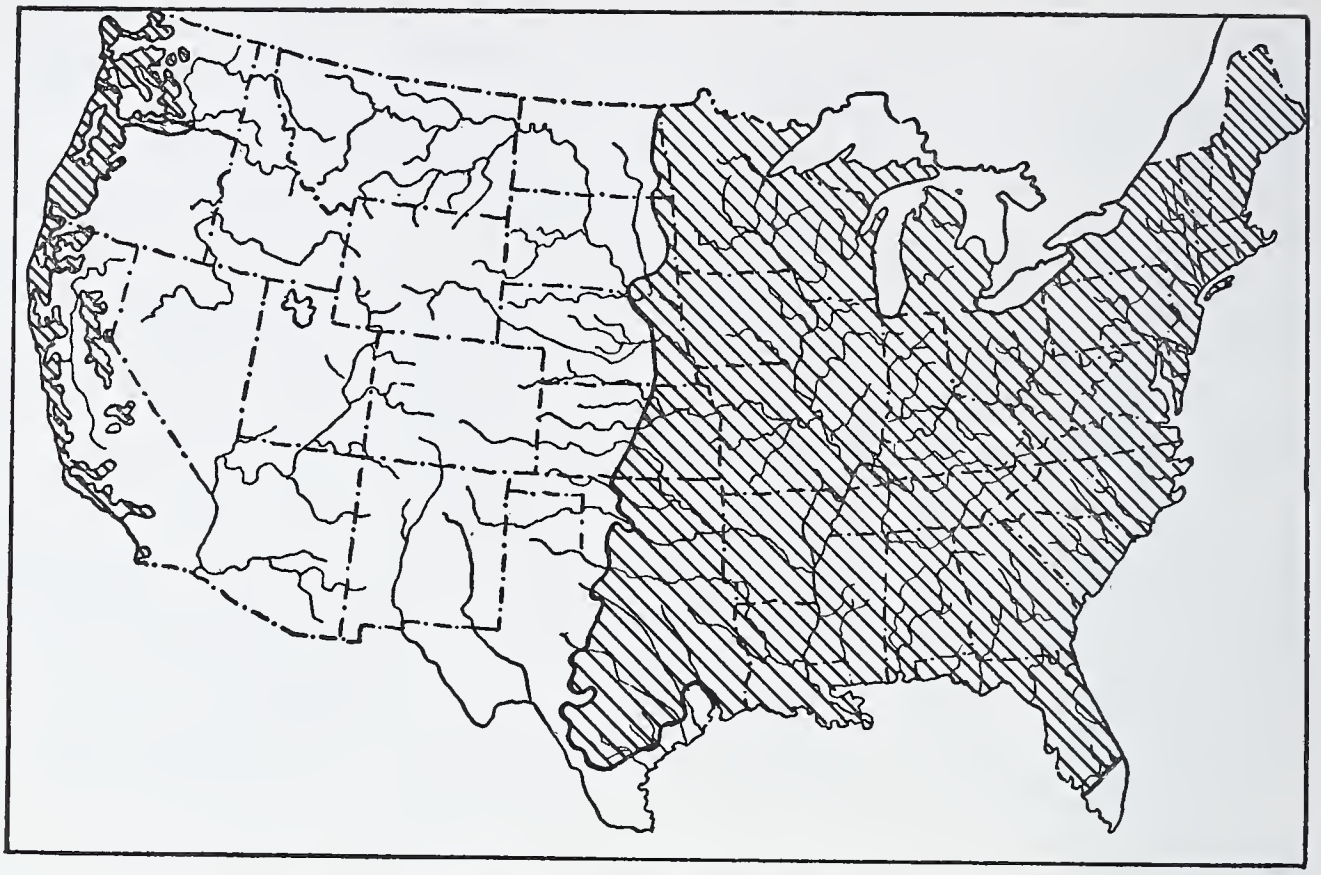


Illustration 36—General range of the maples.

In 1927 maple was the third most important hardwood in proportion to lumber cut. Its occurrence is limited to the eastern part of the United States, with the exception of one species found in the western part of the country—the big leaf maple of Oregon. As a rule, hard maple grows in association with beech and the birches, but it often occurs in pine stands. It is found in rich, well drained, upland sites.

The soft maples often frequent sites closely adjacent to rivers and streams.

The Appalachian region produces hard maple which is somewhat soft in texture, but otherwise closely resembles the true hard, or sugar, maple. The large bulk of hard maple is now located in the Lake States regon.

Usual Names:

Hard maple—sugar maple, rock maple
Silver maple—soft maple, swamp maple
Red maple—soft maple, swamp maple, scarlet maple

Also Called

Sugar Maple:

Sugar maple (Me., N. H., Vt., Mass., R. I., Conn., N. Y., N. J., Pa., Del., Va., W. Va., N. C., S. C., Ala., La., Ky., Mo., Ohio, Ill., Ind., Iowa, Kans., Nebr., Mich., Minn., Wis., Ontario)

Hard maple (Vt., R. I., N. Y., N. J., Pa., Va., Ala., Ky., N. C., Mo., Kans., Nebr., Ill., Ind., Iowa, Mich., Ohio, Minn., Ontario, trade)

Sugar-tree (Me., Vt., R. I., Pa., Va., N. C., W. Va., Ala., Miss., La., Ark., Ky., Mo., Ill., Ind., Ohio, Kans.)

Rock maple (Me., Vt., N. H., Conn., Mass., R. I., N. Y., Tenn., Ill., Mich., Iowa, Kans., Wis., Minn., Ont., trade)
Black maple (Ky., W. Va., N. C.)
Sweet maple (Ky.)
Maple (W. Va., S. C., trade)
Sugar (W. Va.)
White maple (trade)
Rough maple

Black Maple:

Black sugar maple (Mich., Mo.)
Black maple (Mich., Iowa.)
Hard maple (Minn., trade)
White maple

Silver Maple:

Silver maple (Me., Vt., Mass., R. I., N. Y., N. J., Pa., Del., Md., Va., W. Va., N. C., S. C., Fla., Miss., Ky., Ohio., Ill., Ind., Mo., Kans., Nebr., Iowa, Mich., Minn., S. Dak.)
Soft maple (Vt., N. H., Mass., R. I., N. Y., N. J., Pa., W. Va., Ala., Miss., La., Tex., Mo., Ohio, Mich., Ont., Ill., Ind., Kans., Nebr., Iowa, Wis., Minn., S. Dak., trade)
River maple (Me., N. H., R. I., W. Va., Minn.)
White maple (Me., Vt., N. Y., R. I., N. J., Pa., W. Va., N. C., S. C., Ga., Fla., Ala., Miss., La., Ky., Mo., Ill., Ind., Kans., Nebr., Minn.)
Silver-leaved maple (Del., N. J.)
Water maple (Pa., W. Va.)
Creek maple (W. Va.)
Swamp Maple (W. Va., Md.)

Red Maple:

Red maple (Me., N. H., Vt., Mass., R. I., Conn., N. Y., N. J., Pa., Del., Md., Va., W. Va., N. C., S. C., Ga., Fla., Ala., Miss., La., Tex., Ky., Mo., Ill., Ind., Ohio, Ont., Iowa, Wis., Nebr.)
Swamp maple (Vt., N. H., Mass., Conn., R. I., N. Y., N. J., Pa., Del., N. C., S. C., Fla., Ala., Miss., La., Tex., Mo., Ind., Ont., Minn.)
Soft maple (Vt., Mass., N. Y., Va., Miss., Mo., Ill., Ind., Ohio, Ont., Mich., Kans., Nebr., Minn., trade)
Water maple (Miss., La., Tex., Ky., Mo.)
White maple (Me., N. H., W. Va.)
Shoe-peg maple (W. Va.)
Erable (La.)
Ah-weh-hot-kwah—"Red flower" (Onondaga Indians, N. Y.)
Scarlet maple (Tex.)
Maple (N. C.)

Description

The wood of the soft maples resembles hard maple in appearance, but is lighter in color and is not so heavy, hard, and strong.

The heartwood of the maples varies in color from a light reddish-brown to a decided red cast. The sapwood is white.

Sugar maple is heavy, hard, and stiff. It is strong and has good shock-resisting properties.

Maple belongs to the diffuse-porous group of hardwoods, is uniform in texture, wears well under abrasion, and is considered an excellent wood for turning. The grain is generally straight.

Maple often produces a remarkable figure, which is best developed in tangential-cut boards. The wood is often "curly," blistered, and "bird's-eye," but these peculiarities are confined to certain trees, rather than being characteristics of the species in general.

Maple finishes with a hard, beautiful polish. It is easily stained and is often veneered, especially the figured types.

Uses

It is said that maple has over three hundred individual and diversified uses.

The natural characteristics of the two maples, "hard" and "soft," have led to specific uses for these species. Hard maple is a favorite where hardness, good finish, and strength are concerned. Large amounts are used in the manufacture of flooring, for which it is much in demand. Furniture, interior finish, and veneers consume a large amount annually. Approximately one-third of the output is consumed in planing mill products.

Soft maple is used particularly for secondary purposes in furniture manufacture, such as backing, drawer bottoms, etc. Large amounts are used in the manufacture of novelty products, woodenware, and low-grade furniture. The following list indicates a few of the more important uses for "hard" and "soft" maple:

Hard Maple:

- Flooring
- Furniture
- Veneers
- Paneling
- Last blocks
- Handles
- Specialty table tops, work benches, etc.
- Musical instruments, cases, etc.
- Spools and bobbins

Soft Maple:

- Boxes and crates
- Secondary furniture
- Body frames
- Veneer baskets and containers
- Ironing boards and woodenware
- Cross ties
- Cooperage
  - slack, heading, etc.

Classifications

Maple is graded according to the following hardwood rules as issued by the National Hardwood Lumber Association.

Standard Inspection—Ash, Beech, Birch, Hard (or Sugar) Maple, Hackberry, Red Alder, and Sycamore.

Grading Rules for Basswood, Soft Elm, Soft Maple, and Buckeye.

Separate grading rules are established for Rotary-cut Maple, Veneers, White Maple (Saps), Maple Flooring, etc.

Maple flooring is graded under rules of the Maple Flooring Manufacturers Association.

(See general list of Associations for addresses.)

Types and Sizes

The following grades and sizes represent maple lumber which is most commonly cut and consumed by manufacturers. It is available either air-dried or kiln-dried, and is carried in stock by representative mills in the producing region:

Hard Maple

TABLE 81

FAS....4/4	5/4	6/4	8/4	10/4	12/4	16/4
No. 1 Com. and Selects....4/4	5/4	6/4	8/4			
No. 2 Common....4/4	5/4	6/4	8/4			
No. 3 Common....4/4						

Soft Maple:

TABLE 82

FAS....4/4	5/4	6/4	8/4		
No. 1 Com. and Selects....4/4	5/4	6/4	8/4	10/4	12/4
No. 2 Common....4/4	5/4	8/4	10/4		
No. 3 Common....4/4	5/4				
Sound and Wormy....4/4	5/4				
Log Run....4/4	5/4	6/4	8/4	10/4	12/4

Unit Packages

Hard maple is generally sold on actual board feet content basis, based on standard grades.

Soft maple, however, is a secondary mill cut species and is sold on log or mill run basis, although it can be purchased on grade basis.

Quartered maple and white (sap) maple are often tallied on width and length piece tally.

Shipping Weights

Shipping weights for maple lumber are as follows:

TABLE 83

MAPLE, SUGAR
(*Acer saccharum*)

Weight per Cubic Foot: Green, 56; Air-dry (12% MC), 44 — Weights per Thousand Feet Surface Measure

(*Courtesy of Hardwood Manufacturers Institute*)

Thickness Inches (Actual)	*Green Weight (Note)*	*Per Cent of Moisture Content* 10%	12%	14%	16%	18%	20%
3/8	1750	1361	1375	1390	1403	1417	1432
13/32	1895	1474	1490	1505	1520	1535	1551
1/2	2333	1814	1834	1853	1870	1890	1909
17/32	2479	1928	1948	1969	1987	2008	2028
5/8	2916	2268	2292	2316	2338	2362	2386
11/16	3208	2495	2521	2548	2572	2598	2625
3/4	3499	2722	2750	2779	2806	2834	2863
13/16	3791	2948	2980	3011	3039	3071	3102
4/4	4667	3630	3667	3704	3741	3778	3816
17/16	4957	3856	3896	3937	3975	4015	4056
19/16	5540	4309	4355	4400	4442	4488	4533

NOTE: Green weights shown herein are predicated on the moisture content of the tree when felled.

To calculate weights at other moisture content see Index—Moisture Content.

TABLE 84

MAPLE, BLACK
(*Acer nigrum*)

Weight per Cubic Foot: Green, 54; Air-dry (12% MC), 40 Weights per Thousand Feet Surface Measure

(*Courtesy of Hardwood Manufacturers Institute*)

Thickness Inches (Actual)	*Green Weight (Note)*	*Per Cent of Moisture Content*					
		10%	12%	14%	16%	18%	20%
3/8	1687	1237	1250	1262	1276	1288	1301
13/32	1828	1340	1355	1368	1382	1395	1409
1/2	2250	1650	1667	1683	1701	1717	1734
17/32	2390	1753	1771	1788	1807	1824	1843
5/8	2812	2062	2084	2104	2126	2146	2168
11/16	3093	2268	2292	2314	2339	2361	2385
3/4	3374	2474	2501	2525	2551	2575	2602
13/16	3656	2681	2709	2735	2764	2790	2818
4/4	4500	3300	3333	3366	3400	3434	3468
17/16	4780	3505	3543	3577	3614	3648	3686
19/16	5343	3918	3960	3998	4039	4077	4119

NOTE: Green weights shown herein are predicated on the moisture content of the tree when felled. To calculate weights at other moisture content see Index—Moisture Content.

TABLE 85

MAPLE, SILVER
(*Acer saccharinum*)

Weight per Cubic Foot: Green, 45; Air-dry (12% MC), 33 Weights per Thousand Feet Surface Measure

(*Courtesy of Hardwood Manufacturers Institute*)

Thickness Inches (Actual)	*Green Weight (Note)*	*Per Cent of Moisture Content*					
		10%	12%	14%	16%	18%	20%
3/8	1406	1021	1031	1042	1052	1063	1073
13/32	1524	1106	1117	1128	1140	1152	1162
1/2	1875	1362	1374	1389	1403	1418	1430
17/32	1992	1447	1460	1476	1491	1506	1520
5/8	2344	1702	1718	1736	1754	1772	1788
11/16	2578	1872	1890	1910	1929	1949	1967
3/4	2813	2042	2062	2083	2105	2126	2146
13/16	3047	2213	2233	2257	2280	2304	2324
4/4	3750	2722	2750	2778	2806	2834	2862
17/16	3985	2893	2921	2951	2982	3012	3040
19/16	4454	3234	3264	3298	3333	3367	3397

NOTE: Green weights shown herein are predicated on the moisture content of the tree when felled. To calculate weights at other moisture content see Index—Moisture Content.

TABLE 86

MAPLE, RED
(*Acer rubrum*)

Weight per Cubic Foot: Green, 50; Air-dry (12% MC), 38 — Weights per Thousand Feet Surface Measure

(*Courtesy of Hardwood Manufacturers Institute*)

Thickness Inches (Actual)	*Green Weight (Note)*	*Per Cent of Moisture Content*					
		10%	12%	14%	16%	18%	20%
3/8	1562	1176	1188	1200	1212	1224	1236
13/32	1693	1274	1287	1300	1313	1326	1339
1/2	2083	1568	1584	1600	1616	1632	1648
17/32	2213	1666	1683	1700	1717	1734	1751
5/8	2604	1960	1980	2000	2020	2040	2060
11/16	2864	2156	2178	2200	2222	2244	2266
3/4	3125	2352	2376	2400	2424	2448	2472
13/16	3385	2548	2574	2600	2626	2652	2678
4/4	4167	3135	3167	3199	3231	3263	3296
17/16	4427	3332	3366	3400	3434	3468	3502
19/16	4948	3724	3762	3800	3838	3876	3914

NOTE: Green weights shown herein are predicated on the moisture content of the tree when felled.

To calculate weights at other moisture content see Index—Moisture Content.

Ordering

(Follow general instructions under Ordering.)

Caution

Maple lumber sometimes contains so-called "mineral streaks" or mineral stain in the wood. These are not objectionable except for finishing purposes.

Soft maple lumber seems to be susceptible to worm attack. Note that in grading rules for No. 2 and No. 3 Common, worm holes are permissible, inasmuch as only *sound* cuttings instead of clear-face cuttings are allowed.

There is quite a sharp range in values between the upper grades of hard maple. Soft maple is a much less expensive wood than hard maple.

Special Service Requirements

Hard maple is a "universal" industrial specialty wood. For any purpose where hardness, strength, wearing ability, and good finish are required, it is very desirable.

Soft maple is a weaker and softer wood, but for many purposes can be used interchangeably with hard maple. Soft maple is often substituted for basswood, poplar, etc.

Specifications

The following publications may be consulted for information regarding specifications for maple:

Standards and Specifications in the Wood-Using Industries—Bureau of Standards.
National Directory of Commodity Specifications—Bureau of Standards.

(See general Bibliography for publishers' addresses.)

Engineering Data

(See Table 2.)

Improvements

(See general discussion on this subject.)

Associations

The following associations will be glad to give information regarding lumber and other stock cut from maple:

National Hardwood Lumber Association (Grading rules for lumber, veneer, etc.).
Hardwood Manufacturers Institute (Production figures and prices).
Northern Hemlock and Hardwood Association (General information and data).
Appalachian Hardwood Club (General information and data).
National Lumber Manufacturers Assn. (General information).
Maple Flooring Manufacturers Association (Maple flooring rules).

(See general list of Associations for addresses.)

Publications

The following publications frequently carry trade items regarding maple, prices, and other data:

American Lumberman
American Woodworking Review
Hardwood Buyers Guide
Hardwood Record
Industrial Woodworking
Lumber Trade Journal
Lumbermen's Clearing-House Buyers' Guide
Memphis Lumberman and Southern Woodworker
Millwork
Mississippi Valley Lumberman
National Lumberman
National Retail Lumber Dealer
New York Lumber Trade Journal, The
Pennsylvania Lumberman
Retail Lumberman
Retail Lumber Trade News
Southern Lumberman
Southern Lumber Journal
Veneers
Wood Workers Clearing House Journal
Wood Construction
Wood Preserving News
Wood-Workers, The
Wood Working Industries

(See general list of Periodicals for publishers' addresses.)

Bibliography

The following books and articles may prove useful to readers desiring further information:

Uses of Commercial Woods of the United States (Beech, Birches, and Maples)—Hu Maxwell.
"Maple"—Forest Service Leaflet, *American Wood Series.*
Identification of Furniture Woods—Arthur Koehler.
Lumber and Its Uses—R. S. Kellogg.
American Forest Trees—Henry H. Gibson.

(See general Bibliography for publishers' addresses.)

Abbreviations and Terminology

Sft. maple—soft maple
Hd. maple—hard maple

(See general list of Abbreviations and Glossary.)

THE OAKS

(Hardwoods)

This chapter includes information on both white oak and red oak, each of which is discussed in the two following chapters.

ANNUAL PRODUCTION (1928) ..... 1,830,260,000 bd. ft.
AVERAGE VALUE OF LUMBER CUT AT MILL PER M.B.F. (1928) $35.23
TIMBER STAND (1925) (Estimated) ..... 157,372,000,000 bd. ft.

PRINCIPAL STATES PRODUCING CUT—IN ORDER OF IMPORTANCE (1928):

Arkansas, Louisiana, Tennessee, West Virginia, Mississippi, Virginia, Kentucky, Texas, Alabama, North Carolina, Maine, Pennsylvania, Ohio.

General Range of Species

(See individual range for various species.)

Widely distributed over northern and southern United States.

The oaks are considered among the most important trees in this country, and since the beginning of American history have played an important part in the development of America's industries.

Over sixty species and varieties have been classified, and without a doubt there is more confusion concerning trade names, nomenclature, properties, etc., of the oaks than exists in regard to any other species.

Probably only about twenty are of commercial importance in the production of oak lumber.

It has been found advisable to separate these into two distinct groups: the white oaks and the red oaks (including the so-called black oaks).

Botanically, these species are separated according to the manner in which the acorns ripen; i.e., white oaks develop and ripen their acorns in one year; the red oaks, in two years.

The lumbermen generally have adopted the two groups as simply white oaks and red oaks, and base their distinction on the color and character of the wood, rather than upon botanical variation. Fortunately, they follow each other closely.

The general classifications of some of the more important species are as follows:

The white oak group includes: *true white oak*, swamp oak, bur oak, cow oak, post oak, overcup oak, and chestnut oak.

The red oak group includes: *true red oak*, yellow (or black) oak, scarlet oak, Spanish oak, Texas oak, blackjack oak, water oak, willow oak, and laurel oak.

Identification of the Oaks[1]

Very often consumers are anxious to know methods of distinguishing white oaks from red oaks.

[1] Technical Note No. 125, Forest Products Laboratory, Madison, Wisconsin.

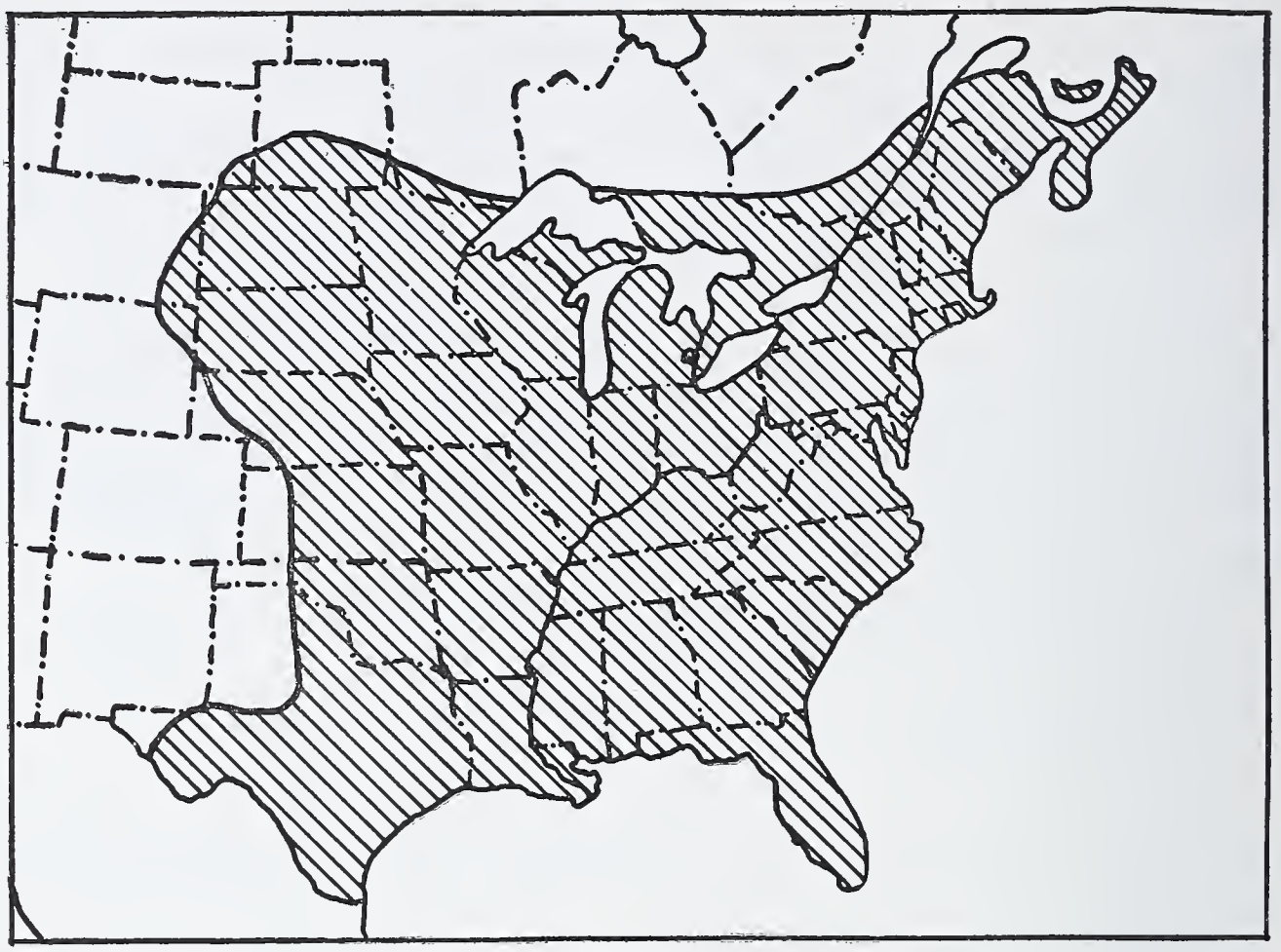


Illustration 37—General range of the oaks.

According to the Forest Products Laboratory:

After the oaks are cut into lumber there is no means known by which they can be identified as to exact species. By examination of the wood alone, however, it is easy to separate the oaks into two groups—the white oaks and the red oaks—and for most purposes it is not necessary to classify them any further.

The oaks all average about the same in strength, but those in the white oak group are much more durable under conditions favorable to decay than those in the red oak group.

The color of the wood is a rapid, but not absolutely reliable, means of distinguishing the white oaks from the red oaks. Red oaks usually have a distinctly reddish tinge, especially near the knots. The wood of the white oaks is generally a grayish-brown, but occasionally a reddish tinge is found in white oak lumber.

For more accurate identification it is necessary to examine the pores of the wood. These will be found as tiny holes on a smoothly cut end surface, the largest being visible to the unaided eye. They are not of uniform size throughout each ring growth, but are considerably larger in the wood formed in the spring, decreasing in size rather abruptly towards the summerwood. The large pores in the springwood of the heartwood and inner sapwood of the white oaks usually are plugged up with a froth-like growth called tyloses, and those of the red oaks are open. This feature, however, is not so reliable for classification as the character of the much smaller pores in the summerwood.

To tell for a certainty whether a piece of oak belongs to the white or red oak group, cut the end grain smoothly with a sharp knife across several growth rings of average width. With the aid of a hand lens examine the small pores in the dense summerwood. If the pores in this part of the growth ring are plainly visible as minute rounded openings, and are not so crowded but that they readily can be counted, the wood belongs to the red oak group. If the pores in the summerwood are very small, somewhat angular, and so numerous that it would be exceedingly difficult to count them, the wood belongs to the white oak group.

THE WHITE OAKS[1]

(Hardwoods)

WHITE OAK *Quercus alba*	POST OAK *Quercus stellata*	CHINQUAPIN OAK *Quercus muehlenbergii*
BUR OAK *Quercus macrocarpa*	COW OAK *Quercus prinus*	SWAMP WHITE OAK *Quercus bicolor*
FORKED LEAF WHITE OAK *Quercus lyrata*	CHESTNUT OAK *Quercus montana*	LIVE OAK *Quercus virginiana*

NOTE.—Statistics, general range of species, suggestions on the identification of oaks and other data which appear in the chapter on The Oaks apply to, or include, the white oaks.

Range of Species

White Oak:

From southern Maine to western Quebec and through southern Ontario, lower peninsula of Michigan (from Lovell's, Crawford County, and Williamsburg, Grand Traverse County, southward), and southern Minnesota, eastern Iowa, southeastern Nebraska and eastern Kansas, Arkansas, and Oklahoma; south to western Florida and Texas (Brazos River).

Bur Oak:

From New Brunswick and Nova Scotia westward through St. Lawrence River Valley to Ontario and on the north shores of Lake Huron to southern Manitoba; southward to Maine (Penobscot River region), Vermont (Lake Champlain), Massachusetts (Ware River), Pennsylvania (Lancaster County), and Delaware; west to Minnesota (Superior National Forest at south end of Birch Lake), the Dakotas (Black Hills and Turtle Mountains), northeastern Wyoming, western Nebraska, central Kansas, and southwestward into central Tennessee, Oklahoma, and Texas (to Nueces River).

Forked Leaf White Oak (Overcup Oak):

From New Jersey (Salem County) and Maryland (Patuxent River, three miles below Laurel), and southward to western Florida and west through the Gulf region to Texas (Navasota River), through Arkansas, southeastern Missouri (near Allenton), central Tennessee, Kentucky, southern Indiana, and Illinois.

Post Oak:

From southern Massachusetts (near Brewster, Cape Cod, and islands), Rhode Island, and New York (Long Island) to western Florida, southern Alabama, and Mississippi; west from Long Island to southern Iowa, Missouri, eastern Kansas, southwestern Arkansas, western and southeastern Oklahoma (Rich Mountain), and central Texas (here south to San Antonio River).

[1] These species are perhaps best known by lumbermen. There are some twenty more species classified in the white oak group.

Cow Oak (Swamp Chestnut Oak):

From New Jersey (Morris and Salem counties) and Delaware (vicinity of Wilmington) to Florida (Citrus and Putnam counties); west in the Gulf region to Texas (Trinity River), and Arkansas and southeastern Missouri to central Tennessee and Kentucky, Illinois (lower Wabash River), and southern Indiana.

Chestnut Oak:

From southern Maine (Saco River and Mount Agamenticus), southern New Hampshire and eastern Massachusetts (Blue Hills) to Maryland and District of Columbia, and in the mountains to northern Georgia and Alabama; westward to Lake Champlain, and the Genesee River in western New York (Perry and Hale counties); (reported in Berrien County, Michigan) southern Ohio, Illinois (west-central Union County), and Indiana to central Kentucky and Tennessee and northeastern Mississippi.

Chinquapin Oak:

From Vermont (Gardiner's Island in Lake Champlain), western Massachusetts and Connecticut, and New York (on Hudson River north of Newburg) westward through New York, southern Ontario and southern Michigan, Wisconsin, northern Iowa, southeastern Nebraska, eastern Kansas, southeastern Oklahoma, southwestern Arkansas; southward in the Atlantic region to the District of Columbia (and upper Potomac River) and western Florida; in central Tennessee and Kentucky; westward in the Gulf states to central and western Texas (Edwards Plateau, Guadalupe Mountains); also in southeastern New Mexico.

Swamp White Oak:

From southern Maine to northern Vermont and southwestern Quebec; west through Ontario and southern peninsula of Michigan, southern Wisconsin (Germantown, Juneau County), to southeastern Minnesota; eastern and southern Iowa, southeastern Nebraska, and western Missouri; south to the District of Columbia, along the Appalachian Mountains to West Virginia, northern Kentucky, and Oklahoma.

Live Oak:

From Virginia (shores of Mobjack Bay), on islands and near the coast, to southern Florida and along the Gulf Coast to western Texas (mouth of Rio Grande and inland to the Red River and Apache and Guadalupe Mountains); southern Mexico and Cuba.

Usual Names

White oak	Post oak	Chinquapin oak
Bur oak	Cow oak	Swamp white oak
Forked leaf white oak	Chestnut oak	Live oak

Also Called

White Oak:

White oak (Me., N. H., Vt., Mass., R. I., Conn., N. Y., N. J., Pa., Del., Va., W. Va., N. C., S. C., Ala., Fla., Ga., Miss., La., Tex., Ky., Mo., Ohio., Ill., Ind., Kans., Nebr., Mich., Wis., Minn., S. Dak. (cult.), Iowa, Ontario)

Stave oak (Ark)
West Virginia soft white oak (trade)
Forked leaf white oak (trade)

Bur Oak:

Bur oak (Vt., N. Y., Pa., Del., W. Va., Ala., Miss., La., Tex., Ark., Mo., Ohio. Ill., Ky., Iowa, Kans., Nebr., Wis., Mich., Minn., No. Dak., S. Dak.)
Mossycup oak (Mass., Pa., Del., Miss., La., Tex., Ark., Ill., Iowa, Nebr., Kans., Ontario, and hort.)
Overcup oak (R. I., Del., Pa., Miss., La., Ky., Ill., Minn.)
Blue oak (Ont.)
Scrub oak (Nebr., Minn., Iowa)
Overcup white oak (Vt.)
Mossycup white oak (Minn.)
White oak (trade)

Forked Leaf White Oak (Overcup Oak):

Overcup oak (N. C., S. C., Ga., Fla., Ala., Miss., La., Tex., Ark., Ill.)
Swamp post oak (Ala., N. C., S. C., Miss., La., Mo.)
Water white oak (S. C., Miss.)
Oak (Ala.)
Swamp white oak (Tex.)
White oak (N. C., trade)

Post Oak:

Post oak (Conn., R. I., N. J., Pa., Del., Md., W. Va., N. C., S. C., Ala., Ga., Fla., Miss., La., Tex., Ark., Tenn., Ky., Mo., Ill., Ind., Iowa, Kans., Ontario)
Box white oak (R. I., D. C.)
Iron oak (Del., Miss., W. Va., Tenn.)
White oak (Ky., Ind., N. C., trade)
Box oak (Md.)
Brash oak (Md.)
Barren white oak (Pa.)
Ridge oak (Ky.)
Rough oak
Turkey oak
Rough white oak

Cow Oak (Swamp Chestnut Oak):

Basket oak (Ala., Miss., La., Tex., Ark.)
Cow oak (Ala., Miss., Tex., Ark., Mo.)
Swamp white oak (Del., Ala.)
Swamp chestnut oak (N. C., Fla.)
White oak (N. C., trade)
Chestnut oak (lit.)

Chestnut Oak:

Chestnut oak (Mass., R. I., Conn., N. Y., N. J., Pa., Del., Md., Va., W. Va., Tenn., N. C., Ala., Ga., Ky.)

Rock chestnut oak (Mass., R. I., Pa., Del., Ala.)
Rock oak (Conn., N. Y., Del., Pa., Ky., N. C.)
Tanbark oak (Tenn., Ala.)
Mountain oak (Ala., N. C., Tenn., Ky., Ga.)
White oak (trade)
White chestnut oak

Chinquapin Oak:

Chestnut oak (Conn., Del., Ala., N. C., Miss., La., Tex., Ohio, Ill., Mich., Kans., Nebr.)
Chinquapin oak (Mass., R. I., Pa., Del., N. C., S. C., Ala., Ark., Miss., Tex., Mo., Ind., Nebr., Kans.)
Pin oak (Kans., Ark.)
Yellow oak (Ill., Kans., Nebr., Mich.)
Scrub oak (N. Y.)
Dwarf chestnut oak (Mass., N. C., Tenn.)
Shrub oak (Nebr.)
White oak (Tenn., trade)
Rock oak (Ark.)
Yellow chestnut oak

Swamp White Oak:

Swamp white oak (Vt., Mass., R. I., Conn., N. Y., N. J., Pa., Del., W. Va., Mo., Ill., Ind., Iowa, Mich., Ont.)
Swamp oak (R. I., Pa., Mich.)
Cherry oak (Del.)
White oak (N. C., trade)

Live Oak:

Live oak

Description

The red oaks and the white oaks are similar in general character, and all have properties in common. They are hard, heavy, strong, fairly easy to work, take finish well, and show a prominent figure when quartered.

Wide variations exist in the quality of the timber, which are not confined to different species, but occur also in different trees of the same species. These variations are due to site conditions, age, growth, etc.

Generally speaking, white oak is the favorite, the species known as true white oak being, perhaps, the best liked of all. In the trade there is a marked preference for the so-called forked leaf white oak, because of its texture and color.

White oak belongs to the ring-porous group of hardwoods. It is less porous than the red oaks and is more durable. The following data will serve to outline prominent characteristics of the important white oak species mentioned above.

True White Oak:

The wood is very strong, stiff, heavy, and durable. It probably excels other associate species in these respects. The heartwood is light brown in color; sapwood nearly white.

Produces excellent "quartered figure." Veneers excellently, shrinks moderately, and dries fairly well, with minimum checking and warping.

Bur Oak:

Weight is approximately the same as true white oak, and both are similar in strength and elasticity. Quarters fairly well, but figure is not quite so frequent as in true white oak. Color of heartwood and sapwood quite similar to true white oak. Seasons quite easily and fabricates well.

Forked Leaf White Oak (Overcup Oak):

The name is often confused, depending upon locality from which the lumber is cut. Often incorrectly called turkey oak (see "Red Oaks"). The wood ranks high in mechanical properties. It is as strong as true white oak, if not stronger. It is tougher, stiffer, and heavier. The heartwood is a rich dark brown color with a pink tinge. Sapwood is lighter. The wood is extremely durable and fabricates well. In some sections the wood is softer-textured than true white oak.

Post Oak:

The wood is extremely heavy and is sometimes referred to as iron oak. It is not considered as good as true white oak. Large amounts are consumed for industrial timbers, cross ties, bridge timbers, car timbers, etc. It is rather difficult to season and is susceptible to checking.

Cow Oak (Swamp Chestnut Oak):

Sometimes called swamp white oak and swamp chestnut oak. Much confusion exists in regard to its name. The wood is hard, heavy, very tough, strong, and durable. Heartwood is light brown; sapwood darker colored. It is lighter in weight than true white oak and perhaps is not quite as strong and elastic. Its figure when quartered is not equal to that of true white oak and is difficult to match. It is a favorite for timber work, cross ties, etc. Seasons poorly and has a tendency to check unless carefully handled in drying.

Chestnut Oak:

A valuable species, which reaches its optimum growth in the Appalachians. It often is used for the same purposes as true white oak and differs little from this species in weight, strength, and stiffness. Heartwood is dark brown in color; sapwood lighter. It is a trifle softer than true white oak and does not finish quite as well. It is not as durable in contact with the ground. It is cut particularly for lumber.

Chinquapin Oak:

Wood is very heavy, hard, strong, stiff, and durable. It is not considered as valuable a wood as true white oak. Some difficulty is experienced in drying, due to checking. Large amounts of this oak are being used for the same purposes as true white oak.

Swamp White Oak:

This oak is considered by some fabricators to be the poorest of the white oaks. This is probably because of the difficulties which develop in seasoning of lumber cut from trees found in the overflow bottoms in the South. The wood has a tendency to check, but this can be eliminated through proper handling and seasoning methods. The wood is about the same weight as true white oak and is strong, hard, and tough. Heartwood is light brown;

sapwood is practically the same as the heartwood in color and sometimes is hardly distinguishable. The wood is cut into lumber, but large quantities find their way into use for cross ties, car construction timbers, etc.

Live Oak:

Live oak was for a long time not an important industrial wood. It is very heavy, hard, strong, and tough. It is twice as strong as true white oak and much heavier. In these respects it is one of our leading woods. The wood is hard to machine and fabricate and is difficult to dry. The heartwood is brown, sometimes quite dark. The sapwood is somewhat lighter in color. It polishes well. Recently its use for fabrication purposes has increased, due to its properties being better understood. Formerly its most important use was in shipbuilding in the form of knees and heavy timbers, plank, etc.

Uses

In a general way the various species of white oak are used without respect to the individual species, although true white oaks have perhaps been the favorite, due undoubtedly to their durability, lighter color, and being less porous. The uses are almost too numerous to mention.

The following is a list of a few of their most important uses:

Furniture and office fixtures
Millwork
  flooring, interior trim, doors, windows, paneling, stepping, etc.
Flooring
Veneers
Cooperage, tight
Car construction
  car sills, frames, etc.
Handles
Rims
Spokes
Poles, piling, cross ties, etc.

Classifications

Attention is called to the fact that the same rules are used for the grading of white oaks and red oaks. The National Hardwood Lumber Association has established standard grading rules as follows:

Plain Red and White Oak, and Locust
Quartered Red and White Oak
Bending Oak
Rules for Grading Hardwoods for Construction Work (including the oaks)
Rotary-cut Red Oak, White Oak, and Chestnut
Sawed and Sliced Veneers
  Quartered White and Red Oaks
  Plain White and Red Oaks

Grading rules for oak flooring can be obtained from the Oak Flooring Manufacturers Association.

(See general list of Associations for addresses.)

Types and Sizes

The following sizes and grades are usually available and are carried in stock at representative mills. This lumber is available either air-dried or kiln-dried. The sizes represent stock most commonly used by manufacturers and fabricators:

Quartered White Oak:

TABLE 87

FAS.....1/2	5/8	3/4	4/4	5/4	6/4	8/4	10/4	
No. 1 Com. and Select.....1/2	5/8	3/4	4/4	5/4	6/4	8/4	10/4	
No. 2 Common.....4/4								
Clear Face Strips.....4/4	(2½″ to 5½″ wide)							

Plain White Oak:

TABLE 88

FAS.....3/8	1/2	5/8	3/4	4/4	5/4	6/4	8/4	12/4	16/4
No. 1 Com. and Select.....3/8	1/2	5/8	3/4	4/4	5/4	6/4	8/4	12/4	
No. 2 Common.....5/8	4/4	5/4							
No. 3 Common.....4/4	5/4								
Sound Sq. Edge.....4/4	(and up)								
FAS—Wormy.....4/4	5/4	6/4	8/4	10/4	12/4	16/4			
Sill Stock.....8/4	(12″ wide)								

Most mills are in position to surface stock cut to any size, or supply special cut stock upon request. Widths and lengths are controlled by grading rules.

Heavy timbers, ties, switch ties, vary according to specifications or orders.

Unit Packages

Oak lumber in practically every instance is sold on standard grade basis and actual tally. There are a few mills that have established grades of their own, but in general National Hardwood Lumber Association grading rules are used.

Exposed stock, strips, etc., are often tallied on export tally (piece tally) where this type of information is required.

Shipping Weights

The following tables approximate the shipping weights for the various white oaks:

TABLE 89

OAK, WHITE
(*Quercus alba*)

Weight per Cubic Foot: Green, 62; Air-dry (12% MC), 48 — Weights per Thousand Feet Surface Measure

(*Courtesy of Hardwood Manufacturers Institute*)

Thickness Inches (Actual)	*Green Weight (Note)*	*Per Cent of Moisture Content*					
		10%	12%	14%	16%	18%	20%
3/8	1938	1486	1500	1516	1530	1546	1561
13/32	2100	1609	1625	1642	1658	1674	1691
1/2	2584	1981	2000	2021	2040	2061	2082
17/32	2746	2105	2125	2147	2168	2190	2212
5/8	3230	2476	2500	2526	2550	2576	2602
11/16	3553	2724	2750	2779	2805	2834	2862
3/4	3876	2971	3000	3031	3060	3091	3122
13/16	4199	3219	3250	3284	3315	3349	3383
4/4	5166	3960	4000	4040	4080	4121	4162
17/16	5491	4209	4250	4294	4335	4379	4423
19/16	6137	4704	4750	4799	4845	4894	4944

NOTE: Green weights shown herein are predicated on the moisture content of the tree when felled.

To calculate weights at other moisture content see Index—Moisture Content.

TABLE 90

OAK, BUR

(*Quercus macrocarpa*)

Weight per Cubic Foot: Green, 62; Air-dry (12% MC), 45 Weights per Thousand Feet Surface Measure

(*Courtesy of Hardwood Manufacturers Institute*)

Thickness Inches (Actual)	*Green Weight (Note)*	*Per Cent of Moisture Content*					
		10%	12%	14%	16%	18%	20%
3/8	1938	1392	1406	1421	1435	1450	1464
13/32	2100	1508	1524	1539	1555	1570	1586
1/2	2584	1856	1875	1894	1914	1933	1952
17/32	2746	1972	1992	2013	2033	2054	2074
5/8	3230	2320	2344	2368	2392	2416	2440
11/16	3553	2552	2578	2605	2631	2658	2684
3/4	3876	2784	2813	2842	2870	2899	2928
13/16	4199	3016	3047	3078	3110	3141	3172
4/4	5166	3712	3750	3788	3826	3864	3903
17/16	5491	3944	3985	4026	4066	4107	4148
19/16	6137	4408	4454	4499	4545	4590	4636

NOTE: Green weights shown herein are predicated on the moisture content of the tree when felled. To calculate weights at other moisture content see Index—Moisture Content.

TABLE 91

OAK, POST

(*Quercus stellata*)

Weight per Cubic Foot: Green, 63; Air-dry (12% MC), 47 Weights per Thousand Feet Surface Measure

(*Courtesy of Hardwood Manufacturers Institute*)

Thickness Inches (Actual)	*Green Weight (Note)*	*Per Cent of Moisture Content*					
		10%	12%	14%	16%	18%	20%
3/8	1969	1454	1469	1483	1499	1513	1529
13/32	2133	1576	1591	1607	1624	1639	1656
1/2	2626	1939	1958	1978	1998	2018	2038
17/32	2790	2060	2081	2101	2123	2144	2166
5/8	3282	2424	2448	2472	2498	2522	2548
11/16	3610	2666	2693	2719	2748	2774	2803
3/4	3938	2909	2938	2966	2998	3026	3058
13/16	4267	3151	3182	3214	3247	3279	3312
4/4	5250	3878	3917	3956	3996	4036	4076
17/16	5579	4121	4162	4202	4247	4287	4332
19/16	6236	4606	4651	4697	4746	4792	4841

NOTE: Green weights shown herein are predicated on the moisture content of the tree when felled. To calculate weights at other moisture content see Index—Moisture Content.

TABLE 92

OAK, CHESTNUT
(*Quercus Montana*)

Weight per Cubic Foot: Green, 61; Air-dry (12% MC), 46 Weights per Thousand Feet Surface Measure

(*Courtesy of Hardwood Manufacturers Institute*)

Thickness Inches (Actual)	*Green Weight (Note)*	*Per Cent of Moisture Content*					
		10%	12%	14%	16%	18%	20%
3/8	1906	1423	1438	1452	1466	1481	1495
13/32	2064	1542	1557	1573	1589	1604	1620
1/2	2541	1898	1917	1936	1955	1974	1994
17/32	2700	2016	2037	2057	2077	2098	2118
5/8	3176	2372	2396	2420	2444	2468	2492
11/16	3494	2609	2636	2662	2688	2715	2741
3/4	3811	2846	2875	2904	2933	2962	2990
13/16	4129	3084	3115	3146	3177	3208	3240
4/4	5083	3795	3833	3871	3910	3949	3988
17/16	5399	4032	4073	4114	4155	4196	4236
19/16	6034	4507	4552	4598	4644	4689	4735

NOTE: Green weights shown herein are predicated on the moisture content of the tree when felled.
To calculate weights at other moisture content see Index—Moisture Content.

TABLE 93

OAK, SWAMP WHITE
(*Quercus bicolor*)

Weight per Cubic Foot: Green, 69; Air-dry (12% MC), 50 Weights per Thousand Feet Surface Measure

(*Courtesy of Hardwood Manufacturers Institute*)

Thickness Inches (Actual)	*Green Weight (Note)*	*Per Cent of Moisture Content*					
		10%	12%	14%	16%	18%	20%
3/8	2156	1547	1562	1578	1594	1610	1626
13/32	2336	1676	1693	1710	1726	1745	1762
1/2	2875	2062	2083	2104	2125	2147	2168
17/32	3055	2191	2213	2236	2258	2281	2304
5/8	3594	2578	2604	2630	2656	2684	2710
11/16	3953	2836	2864	2893	2922	2952	2981
3/4	4313	3094	3125	3156	3187	3221	3252
13/16	4672	3351	3385	3419	3453	3489	3523
4/4	5750	4125	4167	4209	4251	4294	4337
17/16	6110	4383	4427	4471	4515	4563	4607
19/16	6829	4898	4948	4997	5046	5100	5149

NOTE: Green weights shown herein are predicated on the moisture content of the tree when felled.
To calculate weights at other moisture content see Index—Moisture Content.

Ordering

For many uses there is no definite need of specifying either red or white oak. However, for specific requirements it is well to mention which particular one is wanted; also, whether stock is to be plain or quartered.

For example:

1 car of approximately 12,000 board feet of 4/4 FAS, Plain White Oak, or

1 car of approximately 15,000 board feet of 6/4 No. 1 Common Quartered Red Oak, or

1 car of approximately 12,000 board feet of 5/4 No. 2 Common Mixed Oak. Interpretation of "Mixed Oak" is shown in grading rules of National Hardwood Lumber Association.

Caution

The following suggestions may be of value in the purchase of oak lumber:

Some oak, particularly swamp varieties, are quite susceptible to checking and splitting. This difficulty can be eliminated almost entirely if recognized procedure in the handling and seasoning of such stock is pursued.

Sound and wormy grades of oak lumber can be used where finish or beauty of grain are not required.

Brashness is sometimes found in the oaks. Many manufacturers specify in their order, "No brash stock will be accepted."

Attention is also called to the amount of sap and mineral streaks allowed in the grading rules for oak lumber.

Special Service Requirements

Oak offers strength and toughness, combined with beauty of color and grain. The durability of the white oaks makes them resistant to decay. The wood finishes and machines well, and holds glue. It also has excellent wearing qualities.

Specifications

The following publications may be consulted for information regarding specifications for oak:

Standards and Specifications in the Wood-Using Industries—Bureau of Standards.
National Directory of Commodity Specifications—Bureau of Standards.

(See general Bibliography for publishers' addresses.)

Engineering Data

(See Table 2.)

Improvements

(See general discussion under this heading.)

Associations

The following associations will be glad to give information regarding lumber and other stock cut from oak:

National Hardwood Lumber Association (Grading rules).

Hardwood Manufacturers Institute (Production figures and prices).

National Lumber Manufacturers Association (General information).

Appalachian Hardwood Club (General information).

Oak Flooring Manufacturers Association (General information).

Hardwood Interior Trim Manufacturers Association (General information on trim).

Northern Hemlock and Hardwood Manufacturers Association (General information).

(See general list of Associations for addresses.)

Publications

The following publications carry trade items regarding oak:

American Lumberman
American Woodworking Review
Gulf Coast Lumberman
Hardwood Buyers Guide
Hardwood Record
Industrial Woodworking
Lumber Co-operator
Lumber Trade Journal
Lumber Worker
Lumbermen's Clearing House Buyers' Guide
Memphis Lumberman and Southern Woodworker
Millwork
Mississippi Valley Lumberman
National Lumberman
National Retail Lumber Dealer
New York Lumber Trade Journal, The
Pennsylvania Lumberman
Retail Lumberman
Retail Lumber Trade News
Southern Lumberman
Southern Lumber Journal
Veneers
Wood Workers Clearing House Journal
Wood Construction
Wood Preserving News
Wood-Worker, The
Wood Working Industries

(See general list of Periodicals for publishers' addresses.)

Bibliography

The following books and articles may prove helpful to readers desiring further information:

Identification of Important North American Oak Woods—G. B. Sudworth and C. D. Mell.
White Oaks in the Southern Appalachians—W. B. Greeley and W. W. Ashe.
Chestnut Oak in the Southern Appalachians—H. D. Foster and W. W. Ashe.
Handbook on Appalachian Hardwoods—David G. White.
Identification of Furniture Woods—Arthur Koehler.
Lumber and Its Uses—R. S. Kellogg.
American Forest Trees—Henry H. Gibson.

(See general Bibliography for publishers' addresses.)

Abbreviations and Terminology

W. O.—White Oak
R. O.—Red Oak
Sft. text.—soft-textured

(See general list of Abbreviations and Glossary.)

THE RED OAKS[1]

(Hardwoods)

TRUE RED OAK *Quercus borealis*	SCARLET OAK *Quercus coccinea*	SOUTHERN RED OAK *Quercus rubra*
TEXAS RED OAK *Quercus texana*	WILLOW OAK *Quercus phellos*	BLACKJACK OAK *Quercus marilandica*
YELLOW OAK *Quercus velutina*	TURKEY OAK *Quercus catesbalei*	LAUREL OAK *Quercus laurifolia*
WATER OAK *Quercus nigra*		PIN OAK *Quercus palustris*

NOTE.—Statistics, general range of species, suggestions on the identification of oaks and other data which appears in the chapter on The Oaks apply to, or include, the red oaks.

Range of Species

True Red Oak:

From Nova Scotia and southern New Brunswick through Quebec and along the north shores of Lake Huron to near Lake Namekagon; south to northern New England, western New York and Pennsylvania (Erie County), central Minnesota, southern Wisconsin, Iowa, Arkansas (Ozark National Forest—Johnson, Van Buren and Newton counties), and northern Michigan; and in the mountains to North Carolina and probably eastern Tennessee.

Texas Red Oak:

Central and western Texas to the Edwards Plateau.

Yellow Oak:

From southern Maine (coast) to northern Vermont, southern western Ontario, southern Michigan, Iowa, southeastern Nebraska; south to western Florida, and west to eastern Kansas, Arkansas, Oklahoma, and eastern Texas (Brazos River).

Scarlet Oak:

From Maine (Androscoggin River) through southern New Hampshire and Vermont and central New York to southern Ontario; west through central Michigan and southern Wisconsin to Missouri; eastern Oklahoma; south to the District of Columbia, Indiana, Illinois, and on the Allegheny Mountains to Kentucky, Tennessee, and Georgia.

Willow Oak:

From New York (Tottenville, Staten Island) to western Florida—usually in the low maritime plain—and through the Gulf region to Texas (Navasota River), and through

[1] A few of the most important species of red (and black) oaks recognized by lumbermen which produce the bulk of commercial "red oak" lumber.

Arkansas, eastern Oklahoma and southeastern Missouri to central Tennessee, northwestern Kentucky, and Illinois (Massac and Pope counties).

Turkey Oak:

In coastal plain region from southeastern Virginia to Florida (Cape Malabar and Peace River) and west to eastern Louisiana.

Southern Red Oak:

From southeastern Pennsylvania and southern New Jersey to central Florida and in the Gulf states to eastern Texas (Brazos River), Oklahoma and Arkansas, southeastern Missouri to middle Tennessee and Kentucky, southern Illinois and Indiana, Ohio (Lawrence County), and West Virginia (Kenawha County).

Blackjack Oak:

From New York (Forbells Landing and Pine Island, Long Island) through northern Ohio, Indiana, Illinois and southern Michigan (Ann Arbor and Lansing) to southeastern Nebraska, central Kansas, Missouri, Arkansas, and Oklahoma; south to Florida and west to Texas (Callahan County).

Laurel Oak:

North Carolina (Craven County) and southward (in the coast region) to Florida (Biscayne Bay and Caloosahatchee River); westward in the Gulf region to Louisiana; ranging inland more or less throughout this territory.

Water Oak:

Southern Delaware to Florida (Indian River and Tampa Bay); west to the Appalachian Mountains and through the Gulf states to Texas (Colorado River); through Arkansas and eastern border of Oklahoma to southeastern Missouri (Black River), middle Tennessee, and Kentucky.

Pin Oak:

Western Massachusetts (Connecticut River) and Connecticut; western New York (Grand Island—Niagara River) to southern Ontario and southern Michigan (Washtenaw, Macomb, and Ottawa counties), westward to Iowa (Muscatine County); southeastern Nebraska (Pawnee County, near Table Rock); south to Maryland, Virginia (Lower Potomac River), North Carolina, southern Kentucky, central Tennessee, southern Arkansas, and northeastern Oklahoma.

Usual Names

True red oak
Texas red oak
Yellow oak
Scarlet oak
Willow oak
Turkey oak
Southern red oak
Blackjack oak
Laurel oak
Water oak
Pin oak

Also Called

Red Oak:

Gray oak (lit.)
Red oak
Canadian red oak (trade)
Northern red oak (lit.)

Texas Red Oak:

Red oak (Tex., trade—in part)
Spotted oak (Tex.)
Spanish oak (Tex.)
Texas red oak

Yellow Oak:

Black oak (Vt., Mass., R. I., N. Y., N. J., Pa., Del., Md., Va., W. Va., N. C., S. C., Ga., Ala., Fla., Miss., La., Tex., Ohio, Ill., Iowa, Kans., Mo., Nebr., Mich., Wis., Minn., Ontario)
Quercitron oak (Del., S. C., La., Kans., Minn.)
Yellow oak (R. I., N. Y., Ill., Tex., Kans., Minn.)
Tanbark oak (Ill.)
Yellow-barked oak (Minn.)
Spotted oak (Mo.)
Yellow-bark (R. I.)
Dyer's oak (Tex.)
Blackjack (Ga.)
Redbush (Ga.)
Red oak (N. C., Tenn., Ky., Ala., La., trade, in part)
Jack oak (Iowa)

Scarlet Oak:

Scarlet oak (Vt., Mass., R. I., Conn., N. Y., N. J., Pa., Md., Del., N. C., Mo., Ill., Ind., Wis., Minn., Mich., Nebr., Iowa, Ontario)
Red oak (Ky., N. C., Ala., Wis., Nebr., Minn.)
Black oak (Mo., Ill., Iowa, Wis.)
Spanish oak (N. C., Southern States)
Span oak (Md.)
Buck oak (Tenn.)
Bastard oak (Va.)
Spotted oak (Tenn., Ky.)

Willow Oak:

Willow oak (R. I., N. Y., Pa., Md., Del., Ala., N. C., S. C., Fla., Miss., La., Tex., Ark., Mo.)
Peach oak (N. J., Del., Ohio)
Water oak (N. C., S. C.)
Swamp willow oak (Tex.)
Red oak (trade, in part)
Pin oak (La., Miss.)
Laurel oak

Turkey Oak:

Turkey oak (Fla., Ga., Ala., Miss., La., Ky.)
Scrub oak (N. C., S. C., Fla., Miss.)
Black jack (S. C.)
Barren scrub oak
Forked-leaf black jack (N. C., S. C.)
Sand Jack
Sand black jack oak (N. C.)
Blackjack oak (Fla.)

Southern Red Oak:
Spanish oak (Del., Md., Va., N. C., S. C., Ala., Fla., Miss., La., Tex., Mo., Ill.)
Finger oak (N. C.)
Red oak (N. C., Va., Tenn., Ky., Ga., Fla., Ala., Miss., La., Ark., trade, in part)
Spanish water oak (La.)
Spotted oak (Ga.)
Turkey oak (N. C., Ky., Tenn., Ga.)
Bastard Spanish oak (Ky.)
Scarlet oak (Ky., N. C.)
Hill red oak (La.)
Southern red oak

Blackjack Oak:
Blackjack (Pa., Del., Md., W. Va., Ky., N. C., S. C., Ga., Ala., Miss., La., Tex., Ark., Mo., Ill., Ind., Kans., Nebr., Mich., Iowa, S. Dak.)
Jack oak (N. Y., W. Va., Miss., Tex., Mo., Iowa, Ohio, Ill., Kans., Nebr.)
Iron oak (Tenn.)
Black oak (Ark., Wis., N. C., Okla.)
Barren oak (Kans., Tenn., Iowa)
Barrens oak (Fla.)
Scrub oak (S. C.)
Ridge oak (Ky.)
Black jack oak (N. C.)

Laurel Oak:
Laurel oak (N. C., S. C., Ala., Fla.)
Swamp laurel oak
Darlington oak (S. C.)
Willow oak (Fla., S. C.)
Water oak (N. C., Ga.)
Pin oak (La., Miss.)

Water Oak:
Water oak (Del., N. C., S. C., Ala., Fla., Miss., La., Tex., Ark., Mo.)
Spotted oak (Tex., Ala.)
Duck oak
Possum oak
Punk oak
Red oak (trade, in part)
Pin oak (Miss., La., Fla.)

Pin Oak:
Pin oak (Mass., Conn., R. I., N. Y., Pa., Del., Va., Md., Ark., Mo., Ill., Wis., Iowa, Kans.)
Swamp Spanish oak (Ark., Kans.)
Water oak (R. I., Ill.)
Swamp oak (Pa., Ohio)
Water Spanish oak (Ark.)
Red oak (trade, in part)

Description

The red oaks are just as commonly confused in the trade as the white oaks. Regional names for many species have been adopted.

The red oaks include the so-called black oaks, and in the trade often are spoken of as mixed oaks. "Mixed shipment" also refers to cars which contain red oak and black oak but may contain white oak.

As a rule the red oaks are found in company with other associate hardwood species. They have an extended range and grow under a variety of site conditions. Red oak generally is not considered as much in favor as white oak. There is a wide range of color, texture, and grain between species and in species.

Quite often in the trade a special preference is shown for the so-called "soft-textured" variety of red oak, characteristic of the Appalachian which is now known as true red oak. The variation in texture is due to growth and site conditions. It appears that the Appalachian region offers conditions which produce this "soft-textured" red and white oak timber.

Other species of red oaks common to the South, especially the so-called "swamp red oak," growing in the low overflow country of the South, are harder-textured and considered difficult to dry.

As a rule the red oaks are much more porous, more brash, and less resistant to decay than the white oaks.

Black oak took its name from the dull dark bark on the tree which appealed to some as more important than the red cast of the wood (red oak). Botanists have developed other means for classifying the black and the red oaks.

True Red Oak:

True red oak is a separate variety of this group. By some it is considered a superior tree producing the best red oak lumber. It is this species which produces the so-called "soft-textured" Appalachian red oak.

This red oak is lighter than white oak and is generally regarded as not being as strong or stiff. It is quite porous.

Texas Red Oak:

This species closely resembles true red oak. Its range is very limited and only recently has it been given separate recognition. It enters the trade simply as red oak.

It is heavier than true red oak and grows rapidly. It is much favored for interior trim, due to its grain and the ease with which it can be matched. The heartwood is reddish-brown. Average specimens are slightly below true red oak in strength.

Yellow Oak:

This species of red oak also is known as black oak (outside bark). Lumbermen refer to it as yellow oak, due to the color of the inside layer of bark. It has a wide range and is cut extensively.

The wood is heavy, hard, strong, and light brown tinged with red. It is one of the heaviest of the red oak group. For most uses it is not quite as good wood as true red oak. Various trees of this species differ greatly, but the finer specimens yield high-grade lumber.

Scarlet Oak:

This wood is about the same as true white oak but is considered stronger and stiffer. It is heavy, hard, and strong. It shows an attractive figure and quarters well. It is a favorite for furniture and in bending works.

Willow Oak:

The leaves of this species are similar to the leaves of the willow tree. It is a red oak. Heartwood is reddish-brown and the sapwood brown. It is approximately the same weight as oak, though considered stronger and less elastic. It is cut in large quantities in the South. Some consider it slightly difficult to dry, but it is a favorite oak due to its figure, color, and finishing properties.

Turkey Oak:

Turkey oak is known by many other names. It is a typical tree of the South, where it is cut and sold as "red oak." Some consider the wood as inferior to true red oak, particularly mill men. Tests, however, show that the wood is stronger and more elastic than white oak, and slightly lighter. The heartwood is light brown tinged with red. Sapwood is lighter. Large quantities are used for rough construction purposes, such as piling, cross ties, and heavy timbers.

Southern Red Oak:

A tree with many names and much confusion exists because of this situation. It is a red oak, typical of the South, where its growth is scattered. The wood is heavy, very hard, and strong. It checks in seasoning unless handled carefully. The heartwood is light red; sapwood much lighter. It weighs less than white oak.

Blackjack Oak:

One of the black oaks with a wide range. It is cut by lumbermen, but is not a favorite. The wood is hard, heavy, and strong, and difficult to season. The heartwood is brown. Mineral streaks and discolorations frequently are present. It is used for rough construction, piling, cross ties, crossing plank, etc., quite extensively. Some also is used for fabrication.

Laurel Oak:

The laurel oak is a typical tree of the overflow bottoms and sites where much water is found. It is cut with other types of red oaks with which it usually grows. It is very heavy and it shrinks, warps, and checks in drying. It is not one of the best of the red oaks.

Water Oak:

This is a typical southern species, frequenting wet and moist sites. It is known by a variety of names. The wood is lighter in weight than white oak, and not as stiff. It seasons with difficulty, and the wood is sometimes coarse, heavy, and hard. It is used for cross ties and crossing plank extensively.

Pin Oak:

Pin oak has a wide range of growth, and prefers wet and moist sites. It is slightly heavier than true red oak. It is hard and strong and quite similar to true red oak. The heartwood is dark brown and the sapwood lighter. It checks and warps in seasoning. It is used in furniture fabrication and for other uses similar to those of true red oak.

Uses

The various members of the red oak group seldom are known on the market by their own names. After the tree is cut into lumber, the resulting product is known simply as red oak lumber.

In general, then, uses are quite similar for the various species, though numerous fabricators specify a particular oak which best fills their needs.

The uses for red oak are almost too numerous to mention. Large quantities are used in furniture fabrication and in millwork. The following is a list of a few of the more important uses:

Furniture and fixtures
chairs, framework, etc.
Millwork
interior trim, panel, flooring, etc.
Car construction
heavy sills, foundation sills, trim, etc.
Vehicle and body parts
spokes, rims, frame members, etc.
Agricultural implements
handles, frames, etc.
Boxes and crates
Hardware
Novelties, etc.

Classification

(See discussion on this subject in chapter on white oaks.)

Types and Sizes

The following sizes and grades usually are available and carried in stock at representative mills. This lumber is available either air-dried or kiln-dried. The sizes listed cover the ones most frequently ordered by fabricators.

Quartered Red Oak

TABLE 94

FAS	4/4	5/4	6/4	8/4
No. 1 Com. and Select	4/4	5/4	6/4	
No. 2 Com	4/4	5/4		
Clear Face Strips	4/4	5/4		
Clear Face Strips	4/4	(2½"—5½" wide)		

Plain Red Oak

TABLE 95

FAS	5/8	3/4	4/4	5/4		
No. 1 Com. and Select	3/8	1/2	5/8	3/4	5/4	6/4
	8/4	10/4	12/4	16/4		
No. 2 Com	5/8	3/4	4/4	5/4		
No. 3 Com	4/4	5/4				
FAS—Wormy	4/4	5/4	6/4	8/4	10/4	
	12/4	16/4				
Clear Face Strips	4/4	5/4				
Sound Square Edge	4/4					
Step Plank	5/4	6/4	8/4			
Sound and Wormy	4/4	5/4	6/4			

Mills are in a position to surface stock to any size or to supply specially cut material when needed.

Width and lengths are controlled by grading rules.

Heavy timbers, square edge stock, switch ties, etc., vary according to specifications or orders.

Unit Packages

(See discussion on this subject in chapter on white oak.)

Shipping Weights

The following tables give approximate shipping weights for red oak lumber.

TABLE 96

OAK, RED

(*Quercus borealis*)

Weight per Cubic Foot: Green, 63; Air-dry (12% MC), 44 Weights per Thousand Feet Surface Measure

(*Courtesy of Hardwood Manufacturers Institute*)

Thickness Inches (Actual)	*Green Weight (Note)*	*Per Cent of Moisture Content*					
		10%	12%	14%	16%	18%	20%
3/8	1969	1361	1375	1390	1403	1417	1432
13/32	2133	1474	1490	1505	1520	1535	1551
1/2	2626	1814	1834	1853	1870	1890	1909
17/32	2790	1928	1948	1969	1987	2008	2028
5/8	3282	2268	2292	2316	2338	2362	2386
11/16	3610	2495	2521	2548	2572	2598	2625
3/4	3938	2722	2750	2779	2806	2834	2863
13/16	4267	2948	2980	3011	3039	3071	3102
4/4	5250	3630	3667	3704	3741	3778	3816
17/16	5579	3856	3896	3937	3975	4015	4056
19/16	6236	4309	4355	4400	4442	4488	4533

NOTE: Green weights shown herein are predicated on the moisture content of the tree when felled. To calculate weights at other moisture content see Index—Moisture Content.

TABLE 97

OAK, YELLOW

(*Quercus velutina*)

Weight per Cubic Foot: Green, 63; Air-dry (12% MC), 43 Weights per Thousand Feet Surface Measure

(*Courtesy of Hardwood Manufacturers Institute*)

Thickness Inches (Actual)	*Green Weight (Note)*	*Per Cent of Moisture Content*					
		10%	12%	14%	16%	18%	20%
3/8	1969	1330	1344	1357	1370	1385	1398
13/32	2133	1440	1456	1470	1485	1500	1515
1/2	2626	1773	1792	1810	1827	1846	1864
17/32	2790	1884	1904	1923	1941	1962	1981
5/8	3282	2216	2240	2262	2284	2308	2330
11/16	3610	2438	2464	2488	2512	2539	2563
3/4	3938	2659	2688	2714	2741	2770	2796
13/16	4267	2881	2912	2941	2969	3000	3029
4/4	5250	3547	3583	3619	3655	3692	3729
17/16	5579	3767	3808	3845	3883	3924	3961
19/16	6236	4210	4256	4298	4340	4385	4427

NOTE: Green weights shown herein are predicated on the moisture content of the tree when felled. To calculate weights at other moisture content see Index—Moisture Content.

TABLE 98

OAK, WILLOW

(*Quercus phellos*)

Weight per Cubic Foot: Green, 67; Air-dry (12% MC), 49 Weights per Thousand Feet Surface Measure

(*Courtesy of Hardwood Manufacturers Institute*)

Thickness Inches (Actual)	*Green Weight (Note)*	*Per Cent of Moisture Content*					
		10%	12%	14%	16%	18%	20%
3/8	2094	1516	1531	1547	1562	1578	1594
13/32	2269	1642	1659	1676	1693	1710	1726
1/2	2792	2021	2042	2062	2083	2104	2125
17/32	2967	2147	2169	2191	2213	2236	2258
5/8	3490	2526	2552	2578	2604	2630	2656
11/16	3839	2779	2807	2836	2864	2893	2922
3/4	4188	3031	3062	3094	3125	3156	3187
13/16	4537	3284	3318	3351	3385	3419	3453
4/4	5583	4042	4083	4124	4165	4207	4249
17/16	5933	4294	4338	4383	4427	4471	4515
19/16	6631	4799	4849	4898	4948	4997	5046

NOTE: Green weights shown herein are predicated on the moisture content of the tree when felled.

To calculate weights at other moisture content see Index—Moisture Content.

TABLE 99

OAK, SOUTHERN RED

(*Quercus rubra*)

Weight per Cubic Foot: Green, 62; Air-dry (12% MC), 41 Weights per Thousand Feet Surface Measure

(*Courtesy of Hardwood Manufacturers Institute*)

Thickness Inches (Actual)	*Green Weight (Note)*	*Per Cent of Moisture Content*					
		10%	12%	14%	16%	18%	20%
3/8	1938	1268	1282	1294	1307	1320	1333
13/32	2100	1374	1388	1401	1416	1430	1444
1/2	2584	1691	1709	1725	1742	1760	1778
17/32	2746	1797	1816	1833	3851	1870	1889
5/8	3230	2114	2136	2156	2178	2200	2222
11/16	3553	2325	2350	2372	2396	2420	2444
3/4	3876	2537	2563	2587	2614	2640	2666
13/16	4199	2748	2777	2803	2831	2860	2888
4/4	5166	3383	3417	3451	3486	3521	3556
17/16	5491	3594	3631	3665	3703	3740	3777
19/16	6137	4017	4058	4096	4138	4180	4222

NOTE: Green weights shown herein are predicated on the moisture content of the tree when felled.

To calculate weights at other moisture content see Index—Moisture Content.

TABLE 100

OAK, SWAMP RED

(*Quercus rubra pagodaefolia*)

Weight per Cubic Foot: Green, 67; Air-dry (12% MC), 48 Weights per Thousand Feet Surface Measure

(*Courtesy of Hardwood Manufacturers Institute*)

Thickness Inches (Actual)	*Green Weight (Note)*	*Per Cent of Moisture Content*					
		10%	12%	14%	16%	18%	20%
3/8	2094	1486	1500	1516	1530	1546	1561
13/32	2269	1609	1625	1642	1658	1674	1691
1/2	2792	1981	2000	2021	2040	2061	2082
17/32	2967	2105	2125	2147	2168	2190	2212
5/8	3490	2476	2500	2526	2550	2576	2602
11/16	3839	2724	2750	2779	2805	2834	2862
3/4	4188	2971	3000	3031	3060	3091	3122
13/16	4537	3219	3250	3284	3315	3349	3383
4/4	5583	3960	4000	4040	4080	4121	4162
17/16	5933	4207	4250	4294	4335	4379	4423
19/16	6631	4704	4750	4799	4845	4894	4944

NOTE: Green weights shown herein are predicated on the moisture content of the tree when felled.

To calculate weights at other moisture content see Index—Moisture Content.

TABLE 101

OAK, LAUREL

(*Quercus laurifolia*)

Weight per Cubic Foot: Green, 65; Air-dry (12% MC), 44 Weights per Thousand Feet Surface Measure

(*Courtesy of Hardwood Manufacturers Institute*)

Thickness Inches (Actual)	*Green Weight (Note)*	*Per Cent of Moisture Content*					
		10%	12%	14%	16%	18%	20%
3/8	2032	1361	1375	1390	1403	1417	1432
13/32	2201	1474	1490	1505	1520	1535	1551
1/2	2709	1814	1834	1853	1870	1890	1909
17/32	2878	1928	1948	1969	1987	2008	2028
5/8	3386	2268	2292	2316	2338	2362	2386
11/16	3725	2495	2521	2548	2572	2598	2625
3/4	4063	2722	2750	2779	2806	2834	2863
13/16	4402	2948	2980	3011	3039	3071	3102
4/4	5417	3630	3667	3704	3741	3778	3816
17/16	5756	3856	3896	3937	3975	4015	4056
19/16	6433	4309	4355	4400	4442	4488	4533

NOTE: Green weights shown herein are predicated on the moisture content of the tree when felled.

To calculate weights at other moisture content see Index—Moisture Content.

Ordering

(See discussion on this subject in chapter on white oak.)

Caution

The figure, grain, and texture of the red oaks vary greatly. The color sometimes is hard to match. Red oak generally does not show as attractive a figure as the white oaks. The wood is quite porous.

Brashness, although evident in red oaks, is not as prevalent as in white oaks. Its occurrence, however, should be watched.

Seasoning difficulties are quite common with red oak. A dry-kiln system for drying should be used which has proved practical in the drying of red oak stock in order to minimize checking, warping and other degrading defects.

(See discussion on this subject in chapter on white oak.)

Special Service Requirements

Generally speaking red oak is not considered as durable as the white oaks. Red oak does not exhibit quite as attractive a figure as does white oak, and it is more difficult to match for color.

Red oak is much more porous than is white oak, but in this and certain other properties there exists great variations in the different species, also among different trees in the same species.

Due to its workability and attractive figure manufacturers frequently demand the so-called "soft-textured" Appalachian red oaks.

Specifications

The following publications may be consulted for information regarding specifications for red oak:

Standards and Specifications in the Wood-Using Industries—Bureau of Standards.
National Directory of Commodity Specifications—Bureau of Standards.

(See general Bibliography for publishers' addresses.)

Engineering Data

(See Table 2.)

Improvements

(See general discussion on this subject.)

Associations

(See discussion on this subject in chapter on white oak.)

Publications

(See list of publications in chapter on white oak.)

Bibliography

(See bibliography in chapter on white oak.)

Abbreviations and Terminology

R. O.—Red Oak

(See general list of Abbreviations and Glossary.)

PERSIMMON[1]

(A Hardwood)

Diospyros virginiana

ANNUAL PRODUCTION (1928) (Estimated) .....1,000,000 to 1,500,000 ft. log scale
AVERAGE VALUE OF LUMBER CUT AT MILL PER M.B.F..... (Not available)
TIMBER STAND (1926) (Estimated) .....600,000 cords
or equivalent of 300,000,000 bd. ft.[2]

PRINCIPAL STATES PRODUCING CUT—IN ORDER OF IMPORTANCE (1928):

Arkansas, Mississippi, Alabama.

Range of Species

Connecticut (Light-house Point, New Haven) and Long Island southward to southern Florida (De Soto County); westward through southern Pennsylvania and Ohio, southern Indiana and Illinois, southeastern Iowa, eastern Arkansas, Oklahoma, southwestern Arkansas, and in the Gulf States to Texas (Colorado River).

In its use persimmon is closely associated with dogwood. The wood is sometimes referred to as American ebony. The tree generally grows to larger size than dogwood and usually is sold in the form of logs. The South now supplies the bulk of persimmon lumber, logs, etc.

Usual Name

Persimmon

Also Called

Persimmon (Conn., N. Y., N. J., Pa., Del., Va., W. Va., N. C., S. C., Ga., Fla., Miss., La., Ky., Mo., Tex., Ark., Ill., Ind., Iowa, Ohio)
Date plum (N. J., Tenn.)
Plaqueninier (La.)
Simmon (N. C., Fla.)
Possumwood (Fla.)
Common persimmon (lit.)
Seeded plum

Description

(For description of wood refer to description of dogwood.)

Uses

Persimmon is used for many of the same purposes as dogwood. The following is a list of a few specialty products for which persimmon is outstanding:

Golf club heads
Shuttles and shuttle blocks
Shoe lasts
Brush backs, handles, etc.

[1] There are only four species or varieties of the persimmon family found in the United States. The species noted above is the only one of commercial importance.

[2] Computed by estimating one cord as the equivalent of 500 bd. ft.

Classifications

There are no standard rules for the grading of dogwood and persimmon. Bolts and logs are generally classified according to grades established by producers and consumers.

Flitches and dimension squares are generally graded under buyers' specifications or special grading rules.

Types and Sizes

No standard sized pieces of persimmon are available. Generally dimension stock is cut in size for rough blocks of varying sizes, subject to further fabrication. Flitched stock generally varies from two inches thick and up and to a large degree depends on the requirements of manufacturers.

Unit Packages

A large percentage of persimmon is consumed in log form. Logs vary in length from 6 to 20 feet, 9 inches and up in diameter. A small percentage is shipped in the form of flitches and in dimension stock. Sizes vary in accordance with consumers' specifications.

Shipping Weights

Shipping weights for persimmon lumber are as follows:

TABLE 102

PERSIMMON

(*Diospyros Virginiana*)

Weight per Cubic Foot: Green, 63; Air-dry (12% MC), 52 — Weights per Thousand Feet Surface Measure

(*Courtesy of Hardwood Manufacturers Institute*)

Thickness Inches (Actual)	*Green Weight (Note)*	*Per Cent of Moisture Content*					
		10%	12%	14%	16%	18%	20%
3/8	1969	1609	1625	1642	1657	1674	1691
13/32	2133	1743	1760	1778	1795	1814	1832
1/2	2626	2146	2166	2189	2210	2232	2254
17/32	2790	2280	2302	2326	2348	2372	2395
5/8	3282	2682	2708	2736	2762	2790	2818
11/16	3610	2950	2979	3010	3038	3069	3100
3/4	3938	3218	3250	3283	3314	3348	3382
13/16	4267	3487	3520	3557	3591	3627	3663
4/4	5250	4290	4333	4376	4420	4464	4509
17/16	5579	4559	4604	4651	4695	4743	4791
19/16	6236	5096	5145	5198	5248	5301	5354

NOTE: Green weights shown herein are predicated on the moisture content of the tree when felled.

To calculate weights at other moisture content see Index—Moisture Content.

Shipping weights for logs are usually figured at 63 pounds to the cu. ft. Average weight for logs varies from 17,000 to 20,000 pounds per 1,000 bd. ft. of log scale.

Ordering

In the purchase of persimmon, care should be exercised to deal with those mills or individuals who specialize in this species.

Specifications and orders should be exact and definitely state limitations in size of stock, defects permissible, amounts of heartwood permissible, etc.

Caution

There is only one characteristic of persimmon which apparently directly affects its use. The wood is susceptible to a brown stain.

Special Service Requirements

Persimmon is ideal for use where hard wearing qualities, strength, and stiffness are required. Persimmon, however, is not considered to be as superior as dogwood in regard to the properties common to both, although both species are used for the same purposes.

(Refer also to special service requirements for dogwood.)

Specifications

Specification data on persimmon are very meager. Manufacturers using this species generally write their own specifications.

Engineering Data

(See Table 2.)

Improvements

(See discussion on improvements under dogwood.)

Associations

The following associations can be consulted for information on utilization, sources of supply, etc., of persimmon:

Dogwood and Persimmon Association.
Hardwood Manufacturers Institute.
National Hardwood Lumber Association.
National Lumber Manufacturers Association.

(See general list of Associations for addresses.)

Publications

The following publications carry trade items regarding persimmon, prices, and other data:

American Lumberman
Hardwood Buyers Guide
Hardwood Record
New York Lumber Trade Journal, The
Southern Lumberman

(See general list of Periodicals for publishers' addresses.)

Bibliography

The following books and articles may prove helpful to readers desiring further information.

The Native Persimmon—Farmers Bulletin No. 685.
Utilization of Dogwood and Persimmon—John B. Cuno.
Lumber and Its Uses—R. S. Kellogg.
American Forest Trees—Henry H. Gibson.

(See general Biblography for publishers' addresses.)

Abbreviations and Terminology

Persimmon is seldom, if ever, abbreviated.

(See general list of Abbreviations and Glossary.)

YELLOW POPLAR[1]

(A Hardwood)

Liriodendron tulipifera

Annual Production (1928) ..... 327,833,000 bd. ft.
Average Value of Lumber Cut at Mill per M.B.F. (1928) $40.10
Timber Stand (1926) ..... 9,730,000,000 bd. ft.

Principal States Producing Cut—in Order of Importance (1928):

West Virginia, Tennessee, Georgia, Alabama, Virginia, Mississippi, North Carolina, South Carolina.

Range of Species[2]

From Rhode Island to southwestern Vermont, and west to Lake Michigan; south to northern Florida, southern Alabama, and Mississippi, west of Mississippi River in northeastern Louisiana, southeastern Missouri and northeastern Arkansas.

Yellow poplar, one of our most important hardwood species, occurs in the forests in scattered growth associated with other hardwoods, particularly oaks, ashes, hickories, etc. It is one of our finest and most splendid forest trees. It obtains its maximum growth and development in sheltered, rich coves in the Appalachians. It received the name "yellow" from the color of the heartwood, which after drying is light yellow or brown.

In the past yellow poplar was heavily cut, and millions of feet of its lumber have been used in this country and abroad. In Europe it is sometimes called "canary wood," and "satinwood," due to its decided sheen and satin-like surface after finishing.

Usual Names

White wood (New England)
Yellow poplar (trade)

Also Called

Tulip tree (Vt., Mass., R. I., Conn., N. Y., N. J., Del., Pa., Va., W. Va., D. C., N. C., S. C., Ga., Ark., Ky., Tenn., Ohio, Ind., Ill., Ont., hort.)
White-wood (Vt., Mass., R. I., Conn., N. Y., N. J., Del., S. C., Ky., Ohio, Ill., Mich., Ont., trade)
Yellow poplar (N. Y., N. J., Pa., Del., Md., Va., W. Va., N. C., S. C., Ala., Ga., La., Ark., Ky., Tenn., Ohio, Ind., Mo., trade)
Tulip poplar (Del., Pa., N. C., S. C., Ill.)
Poplar (R. I., Del., W. Va., N. C., S. C., Tenn., Ark., Fla., Ohio, trade)
White poplar (Pa., Ky., Ind., W. Va., N. C.)

[1] This tree supplies the so-called "whitewood" or "poplar" lumber of the trade. The sapwood is cut and sold on the market as "poplar sap." There is only one species (Liriodendron tulipifera).

[2] Three-fourths of the virgin timber is found in West Virginia, North Carolina, Texas, Kentucky, and Virginia.

Blue poplar (Del., W. Va., Tenn.)
Hickory poplar (Va., W. Va., N. C.)
Popple (R. I.)
Ko-yen-ta-ka-ah-ta—"White tree" (Onondaga Indians, N. Y.)
Basswood (Ohio)
Sap poplar (Ga.)
Canary yellow-wood (Eng. trade name)
Tulipwood (Eng., trade)
Cucumber-tree (N. Y.)
Canoe-wood (Tenn.)
Old-wife's shirt tree (Tenn.)
Soft yellow poplar (trade)
Saddle-tree
Saddle-leaf

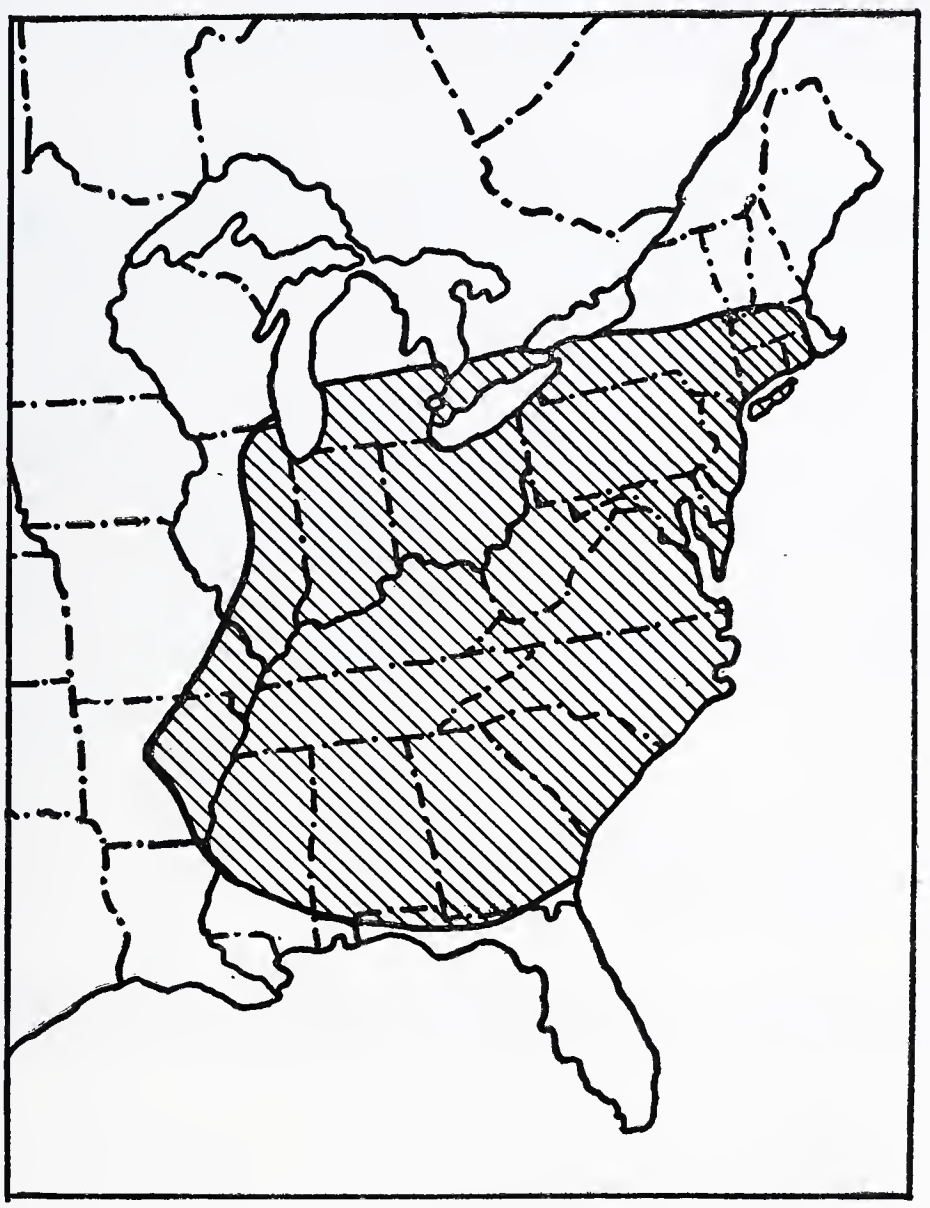


Illustration 38—General range of yellow poplar.

Description

The softness and texture of the wood vary. In its optimum range the wood is soft, even-textured, with a tendency towards brashness, especially in virgin timber. In the northern part of its range it is somewhat harder and stronger. In general, the wood is light in weight, medium soft, and easily worked. It is fairly stiff. The wood belongs to the diffuse-porous group of hardwoods.

It is similar to several other woods in general appearance, such as magnolia, tupelo, buckeye, and basswood. The heartwood is yellowish-brown with a slight tinge of yellow. The sapwood is white and varies in amount, in comparison to the heartwood, among different trees. Virgin timber usually has a narrow band of sapwood, while young timber is often nearly all sap ("poplar saps"). The wood is remarkable for its working qualities. It veneers easily and produces a valuable product. It takes and holds paint, enamel, and finish exceptionally well. The wood is not considered extremely resistant to decay, although it has given excellent service when used for siding, mill timbers, etc.

Yellow poplar does not have a decided or attractive figure and is not usually finished with a natural stain. Proper staining enhances its value for furniture and cabinet work. It seasons easily, holds its shape exceptionally well, and does not impart taste, color, or odor.

Uses

Yellow poplar has always been a highly prized hardwood, the proof of which is in the almost endless number of fabricated products for which the wood is used. Formerly it was greatly desired for construction purposes, but because of its growing scarcity and consequent increasing value certain softwoods have taken its place for such use. The following list will give some idea of the extensive and varied uses for yellow poplar:

Planing mill products
  sash, doors and blinds, millwork
    bevel siding, molding, etc.
Furniture manufacture
  tables, chairs, drawer backs, core stock, etc.
Veneers—panels, built-up stock
  containers, etc.
Fixtures
  interior trim
Woodenware
  ironing-boards, washing-machine parts
  oval dishes, bread boards, etc.
Vehicle parts
  automobile body parts, box boards, etc.
  car construction
Boxes and crates
Musical instruments
Bungs and faucets
Agricultural implements
  handles
Specialty boxes and containers
Caskets and coffins
Pulp and paper

Classifications

Standard grading rules have been established for yellow poplar lumber. These are shown in Hardwood Grading Rules, issued by the National Hardwood Lumber Association.

(See general list of Associations for addresses.)

Attention is also called to separate grades for quartered poplar and box-board stock (see general discussion on Grading Rules).

Types and Sizes

The following grades and sizes represent lumber which is most commonly cut and consumed by manufacturers and fabricators. It is available either air-dried or kiln-dried and is carried in stock by representative mills in producing regions:

TABLE 103

FAS, Quartered....4/4	5/4							
FAS, Plain....1/2	5/8	3/4	4/4	5/4	6/4	8/4		
Saps, Plain....5/8	4/4	5/4	6/4	8/4				
Selects, Plain....4/4	5/4							
Saps and Selects....4/4	5/4	6/4	8/4					
No. 1 Com. and Selects....5/8	3/4	4/4	5/4	6/4	8/4	10/4	12/4	16/4
Panel and Wide No. 1 Common....5/8	4/4	(13"–24" wide)						
Box Boards....4/4	(13"–17" wide)							
No. 2 Common....4/4	5/4							
No. 2 A Common....4/4	5/4	8/4						
No. 2 B Common....4/4	5/4							
No. 3 Common....4/4	5/4							
No. 4 Common....4/4								

Unit Packages

Yellow poplar in practically all instances is sold on a standard grade classification. Small mills, whose cut of poplar is small, sometimes sell on log run or mill run basis. The lumber is tallied on actual board feet content, but very often in certain grades a piece tally (length and width) is made. Lumber for export purposes is usually tallied in this manner.

Shipping Weights

Shipping weights for yellow poplar are as follows:

TABLE 104

POPLAR, YELLOW

(*Liriodendron tulipifera*)

Weight per Cubie Foot: Green, 38; Air-dry (12% MC), 28 Weights per Thousand Feet Surface Measure

(*Courtesy of Hardwood Manufacturers Institute*)

Thickness Inches (Actual)	*Green Weight (Note)*	*Per Cent of Moisture Content*					
		10%	12%	14%	16%	18%	20%
3/8	1188	866	875	883	893	901	911
13/32	1287	939	948	957	967	976	987
1/2	1584	1155	1166	1178	1190	1202	1214
17/32	1683	1227	1239	1251	1265	1277	1290
5/8	1980	1444	1458	1472	1488	1502	1518
11/16	2178	1588	1604	1619	1637	1652	1670
3/4	2376	1733	1750	1766	1786	1802	1822
13/16	2574	1877	1895	1914	1934	1953	1973
4/4	3167	2310	2333	2356	2380	2404	2428
17/16	3366	2455	2479	2502	2530	2553	2581
19/16	3762	2744	2770	2797	2827	2854	2884

NOTE: Green weights shown herein are predicated on the moisture content of the tree when felled.

To calculate weights at other moisture content see Index—Moisture Content.

Ordering

(Follow general directions as shown under this heading.)

As with nearly all other species the buyer will do well to study carefully the grading rules. Frequently perfectly satisfactory lumber in the lower grades can be used at a substantial saving in price.

Caution

Sapwood is considered a defect in certain grades of yellow poplar, and its allowance is limited. Stain is permissible in certain grades.

Note also that No. 2 is sometimes split into two grades; No. 2 A Common and No. 2 B Common. There is a slight variation in price between these two, and fabricators have found that in some instances No. 2 B Common will serve as well as No. 2 A Common.

Mineral streaks—dark-brown discolorations—are frequently found in the heartwood. It does not in any way affect the strength or value of the piece, except in cases where natural finish is desired.

Special Service Requirements

Yellow poplar is a general all-purpose wood. It is available in extra wide stock, such as box boards. It is well suited for veneers and cheaper grades of furniture. The lower grades are well adapted for boxes and crates. Lack of odor, taste, etc., make it exceptionally well suited for use in food containers, specialty boxes, etc. An unfavorable feature of yellow poplar is its lack of strength and hardness, although for most of the purposes for which it is used these qualities are not important.

Specifications

The following publications may be consulted for information regarding specifications for yellow poplar:

Standards and Specifications in the Wood-Using Industries—Bureau of Standards.
National Directory of Commodity Specifications—Bureau of Standards.

(See general Bibliography for publishers' addresses.)

Engineering Data

(See Table 2.)

Improvements

(See general discussion on this subject.)

Associations

The following associations will be glad to give information regarding lumber and other stock cut from yellow poplar:

National Hardwood Lumber Association (Grading rules).
Hardwood Manufacturers Institute (Production figures and prices).
National Lumber Manufacturers Association (General information).
Appalachian Hardwood Club (General information).

(See general list of Associations for addresses.)

Publications

The following publications frequently carry trade items regarding yellow poplar, prices, and other data:

American Lumberman
American Woodworking Review
Gulf Coast Lumberman
Hardwood Buyers Guide
Hardwood Record
Industrial Woodworking
Lumber Trade Journal
Lumbermen's Clearing House Buyers' Guide
Memphis Lumberman and Southern Woodworker
Millwork
Mississippi Valley Lumberman
National Lumberman
National Retail Lumber Dealer
New York Lumber Trade Journal, The
Pennsylvania Lumberman
Retail Lumberman
Retail Lumber Trade News
Southern Lumberman
Southern Lumber Journal
Veneers
Wood Workers Clearing House Journal
Wood Construction
Wood-Worker, The
Wood Working Industries

(See general list of Periodicals for publishers' addresses.)

Bibliography

The following books and articles may prove helpful to readers desiring further information.

Yellow Poplar—Forest Service Circular No. 93.
"Yellow Poplar"—Forest Service Leaflet—*American Wood Series.*
American Forest Trees—HENRY H. GIBSON.
Lumber and Its Uses—R. S. KELLOGG.

(See general Bibliography for publishers' addresses.)

Abbreviations and Terminology

Yel. Pop.—yellow poplar
Y. Pop.—yellow poplar

(See general list of Abbreviations and Glossary.)

SYCAMORE

(A Hardwood)

Platanus occidentalis

Annual Production (1928) ..... 38,454,000 bd. ft.
Average Value of Lumber Cut at Mill per M.B.F. (1928) $30.06
Timber Stand ..... (No figures)

Principal States Producing Cut—in Order of Importance (1928):

Tennessee, Arkansas, Mississippi, Illinois, Indiana, Louisiana, South Carolina, Alabama.

Range of Species

Southwestern Maine to northern Vermont, southern Ontario and Michigan, central and southern Iowa, southwestern Nebraska, eastern Kansas, Oklahoma, and southwestern Arkansas; south to western Florida, central Alabama, and Mississippi, to western Texas.

Practically all of our native sycamore wood comes from a single species which grows throughout nearly all of the eastern half of the United States. It is commonly called in certain localities buttonwood, button-ball, or plane-tree. The principal supply is obtained from the central hardwood region, and is found along the river bottoms adjacent to the large streams and tributaries of the Mississippi River. It is more or less scattered in growth.

Usual Name

Sycamore

Also Called

Sycamore (Vermont, N. H., Mass., Conn., R. I., N. Y., N. J., Pa., Del., Va., W. Va., N. C., S. C., Ga., Fla., Ala., Miss., La., Tex., Ky., Ark., Mo., Ill., Ind., Iowa, Kansas, Mich., Wis., Ohio, Ontario, trade)
Buttonwood (Vt., N. H., R. I., N. Y., N. J., Pa., Del., W. Va., S. C., Ala., Miss., La., Tex., Ark., Mo., Ill., Mich., Minn., Ohio, Ontario)
Button-ball tree (Mass., R. I., Conn., N. Y., N. J., Pa., Del., Miss., La., Mo., Ill., Iowa, Mich., Nebr., Ohio)
Button ball (R. I., N. Y., Pa., Fla.)
Plane-tree (R. I., Del., S. C., Kans., Nebr., Iowa)
Water beech (Del.)
Platane (La.)
Cotonier (La.)
Bois puant (La.)
Oo-da-te-cha-wunnes ("big stockings"), (Indians, N. Y.)
American planetree (lit., hort.)

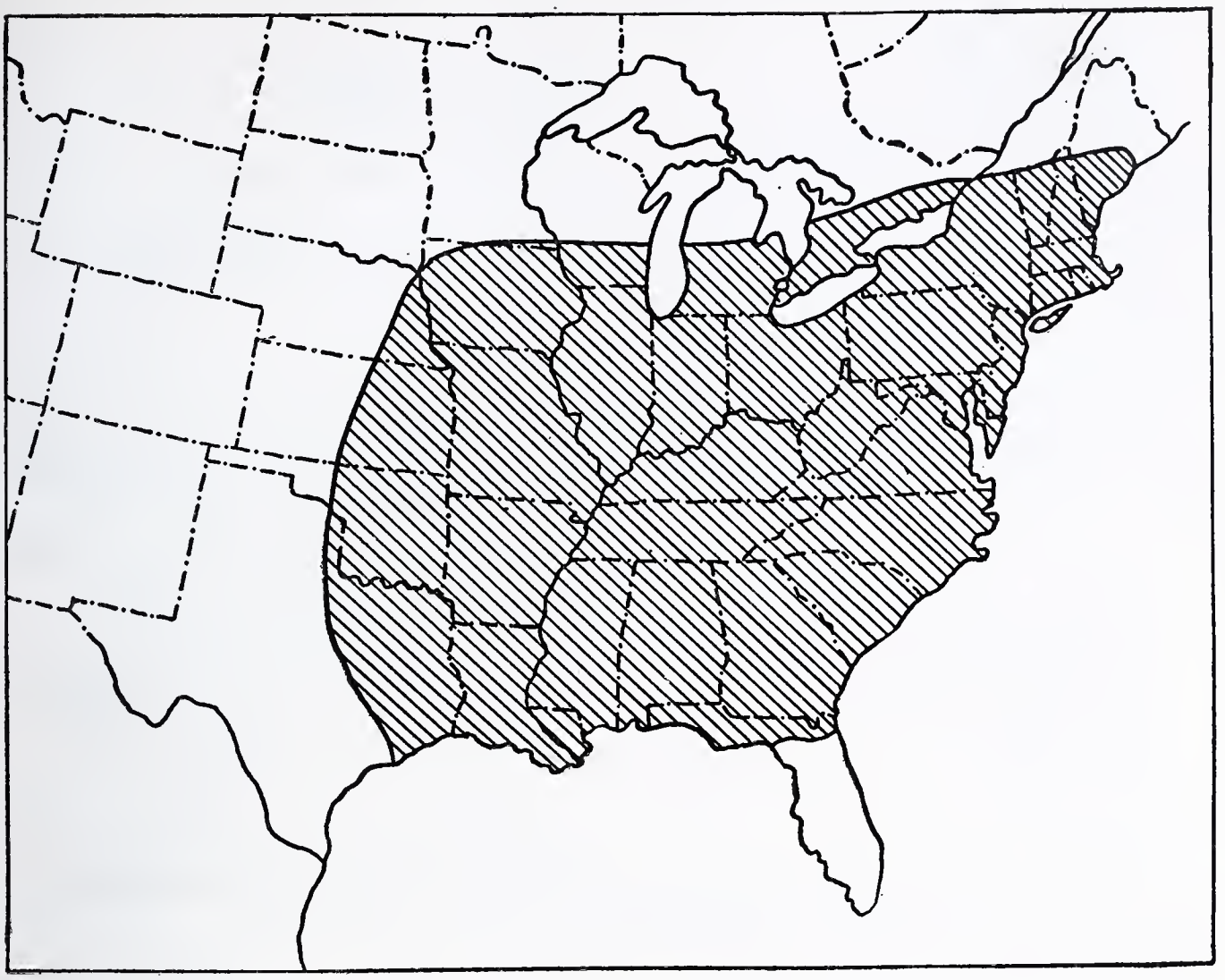


Illustration 39—General range of sycamore.

Description

The wood of sycamore is moderately hard but not strong, is somewhat difficult to work, due to splitting, and belongs to the diffuse-porous hardwoods. The annual rings are very porous. The color is usually uniform, the heartwood light, reddish-brown, and the sapwood light, yellowish-brown. The wood is sometimes brittle, and often has interlocked grain, which produces a ribbon-stripe effect after quartering. This method of sawing often is used to develop the attractive marking of the wood rays. Plain-sawed sycamore shows little figure. Sycamore shrinks moderately and is inclined to warp during drying. However, it is easily kiln-dried, although care must be taken to prevent warp, through proper handling and piling. Sycamore is not durable in contact with the ground, the life of untreated sycamore lumber being placed at three to five years.

Sycamore imparts no odor or taste to substances in contact with it, nor does it stain them.

Uses

Sycamore is confined largely to industrial fabrication, although it is often used for fancy interior panels, trim work, parquet, etc. It is used for veneers for indoor paneling. Also used for various other purposes, the following list including some of the more important:

Boxes and crates
Veneer packages
Slack cooperage
Panel stock, interior trim, etc.
Butchers' blocks
Musical instruments
Furniture (drawer backs)
Veneer and plywood
Toys and novelties
Handles and turned articles

Classifications

Sycamore lumber is graded according to Standard Hardwood Grades, issued by the National Hardwood Lumber Association.

(See general list of Associations for addresses.)

Types and Sizes

The following grades and sizes represent sycamore lumber which is most commonly cut and consumed by manufacturers and fabricators. It is available either air-dried or kiln-dried and is carried in stock by representative mills in producing regions.

TABLE 105

FAS, Qtd	5/8	4/4	5/4		
No. 1 Common, Qtd	5/8	4/4	5/4	6/4	
FAS, Plain	5/8	3/4	4/4	5/4	
No. 1 Common and Select	5/8	3/4	4/4	6/4	8/4
No. 2 Common	4/4	5/4			
No. 3 Common	4/4	5/4			
Log Run, Qtd	5/8	4/4	5/4		
Log Run, Plain	5/8	4/4	6/4	8/4	

Unit Packages

Sycamore is sold on log run, mill run, or standard grade basis. Lumber is measured on board foot basis and tallied by actual board content tally, or export tally.

Shipping Weights

TABLE 106

SYCAMORE

(*Platanus Occidentalis*)

Weight per Cubic Foot: Green, 52; Air-dry (12% MC), 35 — Weights per Thousand Feet Surface Measure

(*Courtesy of Hardwood Manufacturers Institute*)

Thickness Inches (Actual)	*Green Weight (Note)*	*Per Cent of Moisture Content*					
		10%	12%	14%	16%	18%	20%
3/8	1625	1084	1094	1105	1116	1127	1138
13/32	1760	1174	1186	1197	1209	1221	1232
1/2	2166	1445	1459	1474	1488	1502	1517
17/32	2302	1535	1550	1566	1581	1596	1612
5/8	2708	1806	1824	1842	1860	1878	1896
11/16	2979	1987	2006	2026	2046	2066	2086
3/4	3250	2167	2189	2210	2232	2254	2275
13/16	3520	2348	2371	2395	2418	2441	2465
4/4	4333	2888	2917	2946	2975	3005	3035
17/16	4604	3070	3101	3131	3162	3193	3223
19/16	5145	3431	3466	3500	3534	3568	3602

NOTE: Green weights shown herein are predicated on the moisture content of the tree when felled.

To calculate weights at other moisture content see Index—Moisture Content.

Ordering

(See general discussion on this subject.)

Caution

When ordering sycamore it is well to bear in mind that the figure is developed only through quartering. Also, quarter-sawed lumber is less liable to warp and twist and develops less shrinkage than plain-sawed stock.

Special Service Requirements

The general strength, workability, and beautiful figure of sycamore make it admirably suited for certain kinds of cabinet work. It is of little value for construction purposes. It does not impart taste, color, or odor, and is therefore important in the container field.

Specifications

The following publications may be consulted for information regarding sycamore specifications:

Standards and Specifications in the Wood-Using Industries—Bureau of Standards.
National Directory of Commodity Specifications—Bureau of Standards.

(See general Bibliography for publishers' addresses.)

Engineering Data

(See Table 2.)

Improvements

(See general discussion on this subject.)

Associations

The following associations will be glad to give information regarding lumber and other stock cut from sycamore:

National Hardwood Lumber Association (Grading rules and inspection service).
National Lumber Manufacturers Association (General information).
Hardwood Manufacturers Institute (Production figures and prices).

(See general list of Associations for addresses.)

Publications

The following publications frequently carry trade items regarding sycamore, prices, and other data:

American Lumberman
Hardwood Buyers Guide
Hardwood Record
New York Lumber Trade Journal, The
Southern Lumberman

(See general list of Periodicals for publishers' addresses.)

Bibliography

The following books and articles may prove helpful to readers desiring further information:

Utilization of Sycamore—W. D. Brush.
Lumber and Its Uses—R. S. Kellogg.
American Forest Trees—Henry H. Gibson.

(See general Bibliography for publishers' addresses.)

Abbreviations and Terminology

(See general list of Abbreviations and Glossary.)

TROPICAL CABINET WOODS

The apparent increasing use of various so-called "cabinet woods" suggests the following brief discussion of some of those which have become rather popular. Many of these species carry trade names, others are improperly named, while for many the exact species or nomenclature has not been definitely determined.

They are used primarily for veneer purposes, inlay work, and certain cabinet construction; also for specialty purposes, etc.

ACACIA

Melanxylon acacia

Algiers acacia; wood tough; used for inlays.

AMBOYNA

Pterocarpus indicus

Native of Dutch East Indies; wood, beautifully figured and imported mostly in burls; used for inlays.

AVODIRE

Turræanthus africana

Origin, West Coast Africa; used considerably in France for the past several years for furniture, cabinets, etc. Wood, light cream colored; density of mahogany; has very pretty figure. Crotches also in demand for cabinet work. Logs, 8 to 30 feet long, 24 to 60 inches in diameter. Has had considerable demand for past two years for cabinetwork and for show windows.

AYOUS

Triplochiton scleroxylon

Ayous is sometimes called African or bush maple (African primavera), but these are misnomers. It is a native of the African West Coast and ranges from French Guiana to the Cameroons. Veneer produced has a smooth, "tight" surface, dries flat, and takes gloss readily.

The wood is generally uniform in color, being creamy yellow, with sometimes a tinge of brown. The grain is interlocked and is usually quartered.

BALSA

Ochroma lagopus

Balsa is a native of the West Indies and Central America. It is a newcomer to this country, and was most forcibly brought into the limelight during the World War, during which time it was used extensively for life rafts and airplane construction, because of its lightness. Its uses since then have greatly increased.

The wood of the young trees is the more highly prized since it is much lighter in weight than the wood of older trees. The wood in young trees weighs from 7½ to 12 pounds per cubic foot.

The wood is nearly white, sometimes being tinged with a reddish-brown color, with no distinction between heartwood and sapwood. It has a silky luster and is very porous and spongy. It is classified as a hardwood. In general, the wood is light, soft though strong, resilient, and durable. It is half as heavy as cork and half as strong as spruce. It is much used for purposes where extreme lightness is required. Its most important uses are for: lifebuoys, floats, parts of hydroplanes, boat pontoons, toys, hat blocks, pads to prevent breakage in shipment or to prevent the marring of furniture in transit, insulation purposes, and specialty containers and boxes.

BOSSE

Guarea cedrata

Also called pink mahogany (African cedar).

Origin, West Africa. Logs, 30 to 50 inches square, 10 to 18 feet long. Color, pinkish; wood moderately heavy; texture resembling mahogany. Has narrow "stripe" and often beautiful "curl." When cut on quarter splendid matching effects are obtained, and the wood is in great demand for furniture and paneling.

BOXWOOD

Buxus sempervirens

The commercially important species of today comes from Venezuela and is known as West Indian boxwood. Logs average 6 to 10 inches in diameter and are 5 to 12 feet long. The wood is heavy, hard, and dense, has uniform texture and fine grain. It is yellowish-white in color. It is used for the manufacture of rulers and handles and for fine inlay work.

BUBINGA

Didelotia africana

Origin, West Coast of Africa. Used in Europe for many years. It has a rich rose color and has extremely good figure, with broken stripe and beautiful mottle. The wood is hard and dense and takes a fine finish. Logs are 12 to 20 feet long and 30 to 60 inches in circumference. Considerable demand in this country since its recent introduction, and it has proven to be a fine wood for furniture construction.

COCOBOLA

Dalberga retusa (Panama)

Dalberga hypoleuca (Costa Rica)

Also called Honduras, Madagascar, and Indian Rosewood.

Origin, Panama and Costa Rica. A very hard, heavy wood. Shows alternate bright orange and deep red bands, and often dark or black veins streaked through it. By cutting in different ways handsome effects are obtained, and the wood takes a fine, high polish. The logs are generally small and are used mostly for solid work, particularly in the cutlery trade. The larger logs are made into veneers for fancy cabinetwork.

EAST INDIAN SATINWOOD

Chlorxylon swietenia

Also called Ceylon satinwood.

Origin, Ceylon and southern India. Logs are 12 to 30 inches in diameter, 10 to 20 feet long. The wood is a bright golden yellow. It is heavy and hard and has a fine texture. When cut on the quarter it produces a beautiful stripe and often shows a beautiful "bee's-wing" figure. The wood is in great demand for furniture and fine cabinetwork.

EAST INDIAN ROSEWOOD

Dalbergia latifolia

Logs are 18 to 40 inches in circumference, 8 to 15 feet long. Color ranges from light red with straw colored streaks, to deep purple. The wood is hard, heavy, and firm-textured. It makes beautiful veneers and has an extensive demand for fine cabinetwork and paneling.

GREYWOOD

Greywood is a trade name and refers to English hardwood which has been dyed. The process originated in France. Certain iron salts are used which have a chemical action on the natural acids in the woods and produce an attractive metallic sheen. The wood is used particularly for veneers for furniture manufacture, paneling, decorative purposes, etc.

GONCALO ALVES

Astronium fraxinifolium

Also called Zebra wood or Kingwood.

Origin, Brazil. Logs, 10 to 20 feet long, 15 to 30 inches in diameter. Wood straw color with dark red or brown streaks. Close-textured and hard and takes fine polish. In great demand for fine cabinetwork.

HAREWOOD

Acer pseudoplatanus

Otherwise known as English sycamore.

Logs range 15 to 30 inches in diameter, 6 to 16 feet long. Color resembles our maple.

It lends itself to staining better than any other wood. It finishes well and is in considerable demand for furniture, interior trim, and fine cabinetwork.

HOLLY

Ilex aquifolium

Sometimes called ilex, and holm oak.

Native of Europe and America. Ivory white in color. Used chiefly for engravers' blocks and inlay work.

IROKO

Chlorophora excelsa

Origin, West Africa. Sometimes called African teak, kambala, or oak, but resembles teak in color only. The wood is light, yellowish-brown in color, and darkens on exposure to

the air. It is produced in large size logs, 30 to 60 inches in diameter. The wood veneers well, is tough and strong, and glues nicely. Grain is often wavy. Wood takes a fine polish. Used considerably for interior trim.

JAPANESE TAMO

Fraxinus mandschurica

(*Japanese Oak*)

Produced in odd-sized logs and pieces, often only one side of a tree carrying desired effect in figure. Color runs from light gray with greenish cast, to dark brown. The wood shows irregular lines and produces characteristic "peanut" figure. The wood is of medium texture, works well, and takes a fine finish. It is very much in demand for fine cabinetwork.

KOA WOOD

Acacia koa

Origin, Hawaiian Islands. Logs, 12 to 40 inches in diameter. Irregular shaped butts. The color is a rich golden yellow to brown background, with dark brown streaks. Butts produce handsome effects in color and figure. Used in fine furniture and paneling.

KOKO (OR KOKKO)

Albizzia lebbek

Also called "East Indian walnut."

Origin, Andaman Islands. Logs, 12 to 30 inches in diameter, 8 to 16 feet long. Dark brown in color, sometimes with light and dark streaks. Usually has a curly figure. Wood is hard, dense, and close-grained. Finishes well and is very durable. Used in cabinet work and flooring.

LABURNUM

Cystisus laburnum

Known in Ancient Rome as Corsican ebony. It is not a true ebony and is not strong or durable.

LOTUS WOOD

Celtis australis

Native of southern Europe. Similar to American hackberry.

MACASSAR EBONY

Diospyros ebenum

Origin, Dutch East Indies. Logs with heartwood 10 to 30 inches in diameter, 6 to 12 feet long. Color ranges from dark brown and black with light streaks, to light colored background with dark markings.

OLIVE WOOD

Olea europæa

Native of Mediterranean regions. Resembles boxwood. Takes a high polish and is used for inlays and marquetry.

ORIENTAL WOOD

Endiandra palmerstoni

Formerly known as Oriental or Australian walnut.

Origin, Queensland, Australia. Logs, 30 to 7 inches in diameter, 10 to 20 feet long. Color, various shadings of brown, with dark and light stripes or streaks. Cut on quarter produces mottle and finger roll markings, as well as prominent stripe. Wood finishes well and is in demand for furniture and interior trim.

PEAR WOOD

Pyrus communis

The pear wood of commerce is obtained from the common or domestic pear tree. The best logs are obtained from the Tyrol and the bulk of raw material is shipped from Germany. It is often called "German pearwood" or "Tyrolese pear wood." When veneered the wood varies greatly in color and figure. Its outstanding property is the ability to take stains well. Its natural color varies from white with a tinge of brown, to reddish-brown. Pear wood is often treated to imitate ebony.

PEROBA

Peroba branca

Tecoma peroba

Origin, Brazil. Logs average 20 to 40 inches in diameter. Color, light greenish-yellow, often with beautiful figure. Wood is close-grained, is easily workable, and is in demand to some extent for furniture and cabinetwork.

PRIMAVERA

Tabebuia donnell-smithii

Origin, Central America. Logs, 18 to 36 inches in diameter, 10 to 20 feet long. Wood is cream colored. The texture, grain, and figure resemble true mahogany. Cut on the quarter it produces roey figure, with small splash mottle. The wood takes a high polish and is in considerable demand for high-class furniture and interior trim.

SAFFRON WOOD

Elæodendron croceum

Native of South Africa.

Has beautiful figure and grain. The wood is used for veneers.

SILKY OAK

Grevillea robusta

Also called Australian oak Selano.

Origin, Queensland, Australia. Logs, 30 to 60 inches in diameter, 10 to 18 feet long. Color, light brown. When cut on the quarter the wood produces a small flake figure with lustrous sheen. It has a medium texture and finishes well. This wood it also known as Lacewood and enjoys considerable popularity with the furniture trade.

SNAKEWOOD

Brosium aubletii

Origin, principally British Guiana. Logs run small, from 6 to 15 inches in diameter, 6 to 10 feet long. Wood, hard and heavy with fine texture. Color ranges from dark red to salmon pink, with dark or black mottling resembling snake markings. Wood finishes well and takes a high polish. Used principally for canes, handles and fine cabinetwork.

TEAK

Tectona grandis

Origin, Burmah. Imported mostly in flitches and heavy planks, 8 to 12 inches thick, 10 to 30 inches wide, and 10 to 30 feet long. Color, tobacco brown. Wood is moderately heavy and contains a resin or oil which retards decay and makes it practically everlasting for ship work and exposed surfaces. The wood is quite fragrant and repels insects. Besides the uses mentioned above, this wood is in demand for interior trim and paneling, especially when a ripple figure is obtained.

TIGERWOOD

Lovea klainena

Formerly known as African walnut.

Origin, West Coast of Africa. Produced in large-sized logs, either round or square, 30 to 50 inches in diameter. Color, brownish, showing decided light to dark stripes. Wood finishes easily, retains color, and is in considerable demand for furniture and interior trim. It has about the same density as mahogany.

TULIP WOOD

Physocalymma floribunda

(Not to be confused with yellow poplar.)

Native of Brazil. Cream colored background, with beautiful pink stripe. Used for inlay work.

YEW

Taxus boccata

European wood. Reddish-brown in color. Wood, hard, close-grained, takes a high polish, is insect-proof and durable. Japanese yew used for cabinet work and for lead pencils.

VERMILLION

Pterocarpus dalbergioides

Often called African padauk, Adaman redwood, East Indian mahogany.

Logs, 20 to 30 inches in diameter, 10 to 16 feet long. Color, bright crimson to reddish-brown, often carrying fine mottle figure. Wood is dense, hard, and heavy, and takes a high polish, is firm-textured. Used principally in interior trim, furniture and show-case work.

"ZEBRA WOOD"

(Botanical source is not known.)

Also known as "Zebrano" or "Zingana" (African zebrawood.)

Origin, Congo District, East Africa. Wood has light, creamy background, with fine, dark brown lines or stripes resembling zebra markings. Produced in large-sized logs, 30 to 60 inches in diameter, round or square. Wood works well and takes a fine polish. It is in considerable demand for fine cabinetwork.

BLACK WALNUT[1]

(A Hardwood)

Juglans nigra

Annual Production (1928).....56,650,000 bd. ft.
Average Value of Lumber Cut at Mill per M.B.F. (1928).....$112.54
Timber Stand (1925) (Estimated).....1,500,000,000 bd. ft.
Principal States Producing Cut—in Order of Importance (1928):

Ohio, Iowa, Kansas, Indiana, Missouri, Illinois.

Range of Species

Southern Ontario to Florida, central Alabama, and Mississippi, and westward through southern Michigan, Wisconsin, and Minnesota to central and northern Nebraska, eastern Kansas, Arkansas, and Oklahoma, and eastern Texas.

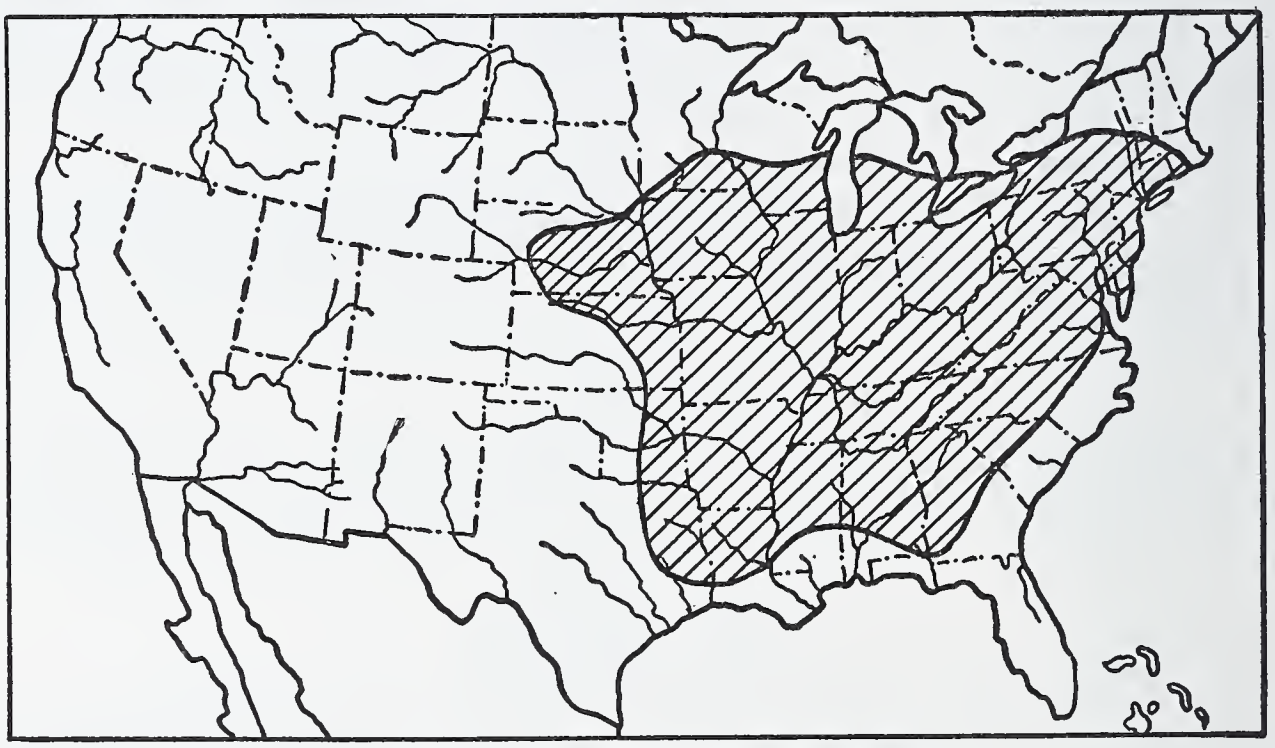


Illustration 40—General range of black walnut.

Although black walnut is one of our most important and valuable hardwoods, the annual cut of lumber is comparatively small. It is a scattered forest tree, but at present a large part of the supply comes from farm wood lots. During the World War (1914–1918) large quantities were demanded, and extensive search indicated that stands of black walnut away from the railroads were much greater than any one thought, insuring a steady supply for many years. The tree is widely distributed.

[1] All of the black walnut lumber in this country is cut from this species. Circassian walnut is a different wood and comes from the Black Sea region (Circassia—in the southern provinces of Russia).

Usual Names

Black walnut American walnut

Also Called

Black walnut (N. H., Vt., Mass., R. I., Conn., N. Y., N. J., Del., Pa., Va., W. Va., N. C., Tenn., Ga., Fla., Ala., Miss., Tex., La., Ark., Ky., Mo., Ind., Ill., Kans., Nebr., Iowa, Mich., Ohio, Ontario, S. D., Minn.)
American black walnut (trade)
Walnut (N. C., Del., W. Va., Fla., Ky., Tenn., Mo., Ohio, Ind., Iowa)
Walnut-tree (Pa., S. C.)
Dent-soo-kwa-no-ne (Round nut, N. Y. Indians)
Gun-wood (trade)
American walnut (trade)

Description

Black walnut is one of our best known woods. Its beauty to a large degree lies in its color, figure, and fine polish. Its strength and stability are also traditional with the cabinet maker. The wood is semidiffuse-porous in structure. The heartwood varies from light brown to a dark, rich brown, sometimes almost chocolate color. The sapwood is white and is not considered as valuable as heartwood unless stained.

The wood is stronger than white oak, weight for weight, but is not so heavy. It is hard and stiff and takes a wonderful polish. It is well adapted for veneering and gluing, staining and finishing. The wood shrinks moderately, is easy to control in kiln-drying, and warp, twist, or check seldom occur.

Stumps, burls, and occasionally whole trees often develop an exquisite figure which is greatly prized for cabinet making. When exposed to the elements the heartwood is quite resistant to decay, while the sapwood decays easily.

Uses

Walnut is a specialty wood and is never used for rough construction. It is usually fabricated at industrial plants into a multitude of products. By far the larger per cent goes into furniture and cabinet specialties, in the form of veneers and lumber. It has always been considered one of the favorite American woods. Gunstock material has always demanded black walnut in its fabrication. Export shipments since the World War have been small, and in the form of lumber and logs. The following list shows some of the most important uses for black walnut:

Household furniture
Interior trim
Office furniture
Radio cabinets
Sewing machines
Commercial fixtures
Gun stocks
Phonographs
Flooring
Woodenware and novelties
Picture frames and moldings
Caskets
Pianos
Automobile trim
Handles and brushes
Manual training
Telephone equipment
Billiard tables
Airplane propellers
Boats and ships
Scientific instruments

Classifications

Black walnut lumber is graded according to Standard Grading Rules for *Walnut and Butternut,* established by the National Hardwood Lumber Association.

(See general list of Associations for addresses.)

Types and Sizes

The following grades and sizes represent lumber which is most commonly cut and consumed by manufacturers and fabricators. It is available air-dried, and to a less extent kiln-dried, and is carried in stock by representative mills in producing regions.

TABLE 107

FAS.....1/2	5/8	3/4	4/4	5/4	6/4	8/4	10/4	12/4	16/4
Selects.....3/4	4/4	5/4	6/4	8/4	10/4				
No. 1 Common.....5/8	3/4	4/4	5/4	6/4	8/4	10/4	12/4	16/4	
No. 2 Common.....4/4	5/4	6/4	8/4	10/4	12/4				

Unit Packages

Black walnut lumber is sold almost universally on standard grade basis. Sometimes small mills are accustomed to selling on log run or mill run basis. In tallying, actual board feet content tally is used for domestic markets. In the export trade in certain markets a length and width piece tally is used to enable manufacturers to know definitely how the stock is running as to length and width.

Shipping Weights

Weights for black walnut lumber are as follows:

TABLE 108

WALNUT, BLACK
(*Juglans nigra*)

Weight per Cubic Foot: Green, 58; Air-dry (12% MC), 39 — Weights per Thousand Feet Surface Measure

(*Courtesy of Hardwood Manufacturers Institute*)

Thickness Inches (Actual)	*Green Weight (Note)*	*Per Cent of Moisture Content*					
		10%	12%	14%	16%	18%	20%
3/8	1812	1206	1219	1231	1243	1256	1268
13/32	1963	1307	1321	1334	1347	1361	1374
1/2	2416	1608	1626	1642	1658	1675	1691
17/32	2567	1709	1727	1744	1761	1780	1797
5/8	3020	2010	2032	2052	2072	2094	2114
11/16	3322	2211	2235	2257	2279	2303	2325
3/4	3624	2412	2438	2462	2486	2513	2537
13/16	3926	2613	2642	2668	2694	2722	2748
4/4	4833	3217	3250	3283	3316	3349	3382
17/16	5134	3417	3454	3488	3522	3560	3594
19/16	5738	3819	3861	3899	3937	3979	4017

NOTE: Green weights shown herein are predicated on the moisture content of the tree when felled.

To calculate weights at other moisture content see Index—Moisture Content.

Ordering

Walnut is a high-priced wood. Special effort should be made to purchase stock from reliable sources. Always buy the shortest and narrowest lumber that you can use economically.

Caution

Steamed sapwood is not a defect in the grading of black walnut and practically all walnut is steamed right after it is cut. In unsteamed lumber certain limitations of sapwood are based upon the length and width of the stock. Extreme care should be exercised in handling, seasoning, and storing of black walnut. Degrade in FAS involves considerable loss of money and should be avoided.

In ordering grades, careful study will enable the manufacturer to ascertain the grades in which cutting sizes are the most economical for his requirements.

Special Service Requirements

For any fabrication where a richly colored natural finish is desired, with beautiful grain and figure, hardness and wearing qualities, black walnut is especially adapted for use. Black walnut also holds its shape well.

Specifications

The following publications may be consulted for information regarding specifications for black walnut:

Standards and Specifications in the Wood-Using Industries—Bureau of Standards.
National Directory of Commodity Specifications—Bureau of Standards.

(See general Bibliography for publishers' addresses.)

Engineering Data

(See Table 2.)

Improvements

Careful study on the part of black walnut producers is constantly being carried on to cut the timber so as to expose the maximum beauty and figure. Careful air-seasoning and drying systems have eliminated the possibility of degrade to a minimum.

(See also general discussion on this subject.)

Associations

The following associations will be glad to give information regarding lumber and other stock cut from black walnut:

American Walnut Manufacturers Association (Complete information on production, uses, finish, prices, etc.).

National Hardwood Lumber Association (Grading rules and inspection service).

(See general list of Associations for addresses.)

Publications

The following publications often carry trade items regarding black walnut, prices, and other data:

American Lumberman
American Woodworking Review
Gulf Coast Lumberman
Hardwood Buyers Guide
Hardwood Record
Lumber Trade Journal
Lumbermen's Clearing House Buyers' Guide
Memphis Lumberman and Southern Woodworker
Millwork
Mississippi Valley Lumberman
National Lumberman
New York Lumber Trade Journal, The
Pennsylvania Lumberman
Southern Lumberman
Southern Lumber Journal
Veneers
Wood Working Industries

(See general list of Periodicals for publishers' addresses.)

Bibliography

The following books and articles may prove helpful to readers desiring further information:

Utilization of Black Walnut—Warren D. Bush.
American Walnut for Interior Woodwork and Paneling—American Walnut Manufacturers Association.
The Story of American Walnut—American Walnut Manufacturers Association.
Architectural Specifications on American Walnut—American Walnut Manufacturers Association.
Black Walnut for Timber and Nuts—Wilbur R. Mattoon.
Selling Black Walnut Timber—Warren D. Bush.
Black Walnut—Its Growth and Management—F. S. Baker.
From Nature's Treasure Chest—G. Bergstrom.
Veneers and Plywoods—E. Vernon Knight and Meinrod Wulpi.
American Forest Trees—Henry H. Gibson.

(See general Bibliography for publishers' addresses.)

Abbreviations and Terminology

Bl. walnut—black walnut
R.C. walnut—rotary cut walnut
Sp. walnut—sap walnut

(See general list of Abbreviations and Glossary.)

SOFTWOODS

(See Index for other names)

THE CEDARS

(Softwoods)

PORT ORFORD CEDAR
Chamæcyparis lawsoniana

SOUTHERN WHITE CEDAR
Chamæcyparis thyoides

YELLOW CEDAR (OR CYPRESS)
Chamæcyparis nootkatensis

NORTHERN WHITE CEDAR
Thuja occidentalis

WESTERN RED CEDAR
Thuja plicata

EASTERN RED CEDAR
Juniperus virginiana

INCENSE CEDAR
Libocedrus decurrens

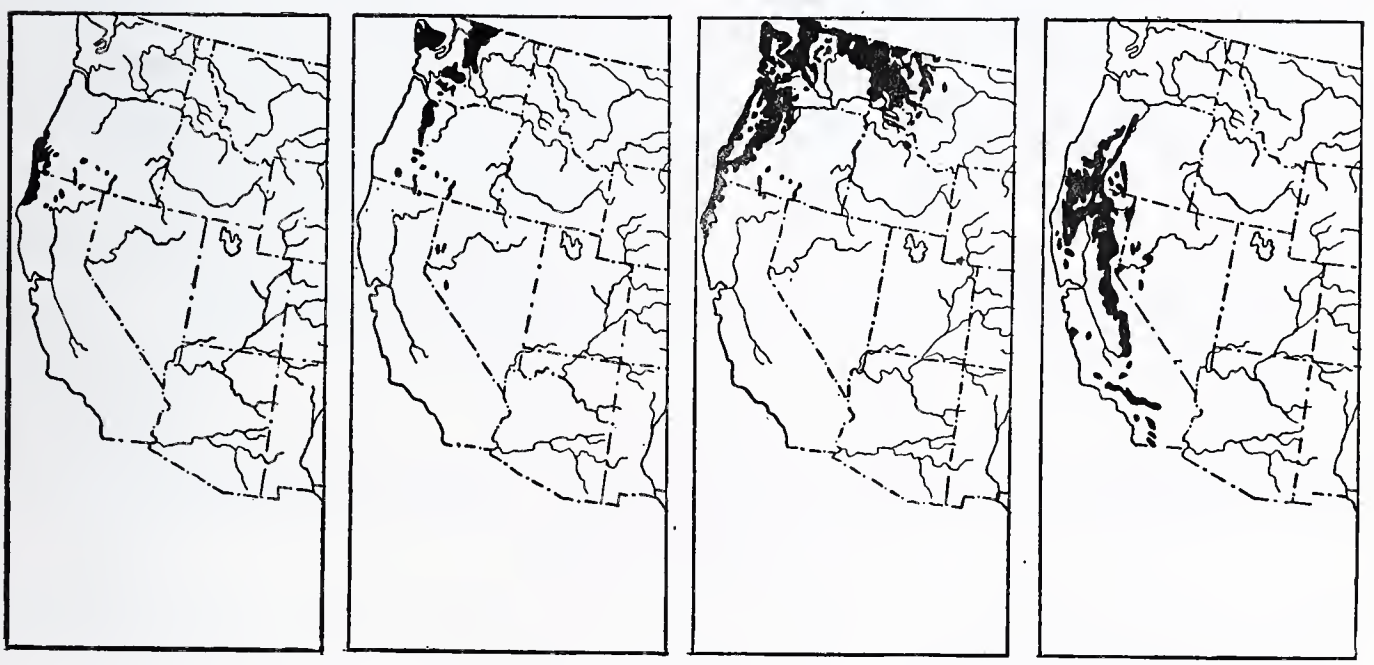


Illustration 41—Port Orford. *Illustration 42*—Yellow. *Illustration 43*—Western red. *Illustration 44*—Incense.

General ranges of the cedars.

ANNUAL PRODUCTION (1928).....266,774,000 bd. ft.
AVERAGE VALUE OF LUMBER CUT AT MILL PER M.B.F. (1928).....$38.32
TIMBER STAND (1920):

Port Orford cedar (1920).....500,000,000 bd. ft.
Southern white cedar (1925).....(No figures)
Yellow cedar (or cypress) 1925.....10,000,000,000 bd. ft.
Northern white cedar (1923).....6,000,000,000 " "
Western red cedar (1925).....53,248,000,000 " "
Eastern red cedar (1927).....250,000,000 " "
Incense cedar (1925).....10,000,000,000 " "

PRINCIPAL STATES PRODUCING CUT—IN ORDER OF IMPORTANCE (1928):

The species of cedar covered by the following table are:

Western Red Cedar; cut in Washington, Oregon, and Idaho
Port Orford Cedar; cut in Oregon
Southern White Cedar; cut in the Atlantic Coast States
Yellow Cedar (or Cypress); cut in Washington
Northern White Cedar; cut in the Lake States and in the Northeastern States
Eastern Red Cedar; cut principally in Tennessee, Florida, and Alabama
Incense Cedar; cut in California

The term "cedars" is a general name given to all of the fragrantly scented softwoods. In the trade, cedar is classified into several groups; namely, Port Orford cedar, southern

Illustration 45—Northern white.

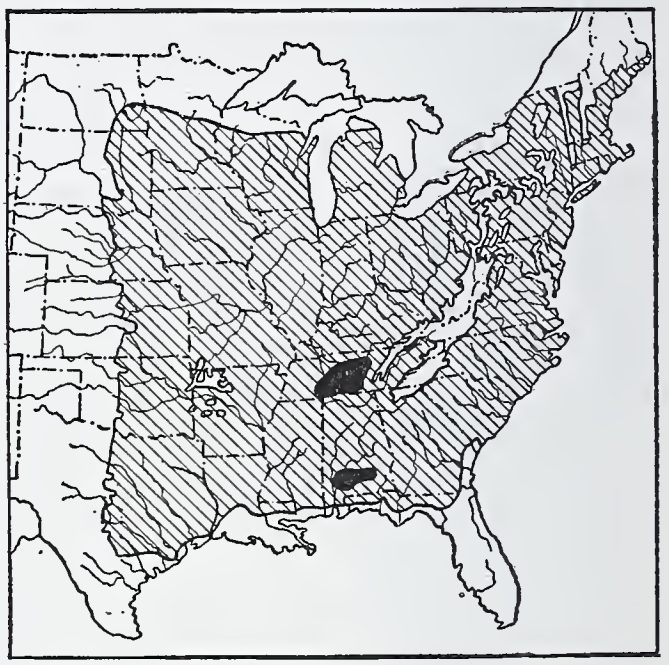


Illustration 46—Eastern red.

General ranges of the cedars.

white cedar, yellow cedar (or cypress), northern white cedar, western red cedar, eastern red cedar, and incense cedar.

TABLE 109

CUT AND AVERAGE VALUE BY STATES OF SPECIES INDICATED

State	*Quantity Cut Board Feet (1928)*	*Average Value per M. Ft. f.o.b. Mill*
Washington	151,970,000	$41.56
Oregon	51,410,000	36.41
Colorado	27,662,000	24.22
Idaho	11,879,000	19.02
North Carolina	5,185,000	59.22
Tennessee	4,380,000	56.79
Alabama	3,387,000	59.29
Maine	2,479,000	
Michigan	2,307,000	
Virginia	1,845,000	35.04
Wisconsin	1,314,000	
Kentucky	1,219,000	

Range of Species

Port Orford Cedar:

Coast region from southwestern Oregon to California, extending inland about forty miles.

Southern White Cedar:

In general, from New Hampshire and coast region, from southern Maine to middle and west Florida; westward to Mississippi; more or less scattered in its occurrence throughout this range; found locally in Dismal Swamp, Virginia, in central South Carolina, and in Talbot County, Georgia.

Yellow Cedar (or Cypress):

From southwestern Alaska southward in the coast region through British Columbia, Washington, and Oregon (in Cascade Mountains as far as the Santiam River and Mount Jefferson); east in Washington to the headwaters of Yakima River; in southern Oregon (Josephine County, Siskiyou Mountains—Whiskey Peak); in western Oregon (south-central Lane County).

Northern White Cedar:

From Nova Scotia and New Brunswick to Lake Winnipeg, and south to central Minnesota and Michigan, northern Illinois and Indiana and in the Atlantic region to New Jersey, and southward along the mountains to North Carolina and northeastern Tennessee.

Western Red Cedar:

From western Idaho, eastern Washington, eastern and southern Oregon, on the Cascades and Sierra Nevadas to southern California.

Eastern Red Cedar:

Nova Scotia and New Brunswick to Georgia, southern Alabama and Mississippi; west in Ontario to eastern North and South Dakota, southern Michigan, eastern Nebraska and Kansas, southeastern Oklahoma, southwestern Arkansas, and eastern Texas.

Incense Cedar:

From Oregon through California; western Nevada; Lower California.

Usual Names

Port Orford cedar
Southern white cedar
Yellow cedar (or cypress)
Northern white cedar
Western red cedar
Eastern red cedar
Incense cedar

Also Called

Port Orford Cedar:

Port Orford cedar (Ore., Calif. and trade)
Oregon cedar (Ore., Calif.)
White cedar (Ore., Calif.)
Ginger pine (Calif.)
Lawson's cypress (Calif., Ore.)
Port Orford (white) cedar (trade)

Southern White Cedar:

White cedar (Mass., R. I., N. Y., N. J., Pa., Del., N. C., S. C., Fla., Ala., Miss.)
Swamp cedar (Del.)
Post cedar (Del.)
Juniper (Ala., N. C., Va., Fla.)
Southern white cedar (trade)
White cedar ("Juniper") (trade)

Yellow Cedar (or Cypress):

Yellow cedar (Ore.)
Sitka cypress (Ore., Calif.)
Yellow cypress (Ore., Wash.)
Nootka cypress (Calif., lit.)
Nootka sound cypress (Cult. Eng.)
Alaskan ground cypress (Calif., lit.)
Alaska cypress (Calif., lit.)
Alaska cedar (trade)
Alaska yellow cedar (trade)

Northern White Cedar:

Arborvitæ (Maine, Vt., Mass., R. I., Conn., N. Y., N. J., Pa., Del., Tenn., Va., W. Va., Ind., Ill., Wis., Mich., Minn., Ohio, Ontario)
White cedar (Maine, N. H., Vt., R. I., Mass., N. Y., N. J., Va., N. C., Wis., Mich., Minn., Ontario, trade)
Cedar (Maine, Vt., N. Y.)
American arborvitæ (N. Y., hort., Eng.)
Oo-soo-ha-tah—"feather-leaf" (Indian)
Vitæ (Del.)
Atlantic red cedar (Calif., lit.)
Michigan white cedar (trade)
Northern white cedar (trade)
New Brunswick cedar (trade)
Swamp cedar (N. Y.)

Western Red Cedar:

Red cedar (Ida., Ore., Wash., Mont., Brit. Col.)
Canoe cedar (Ore., Wash.)
Arborvitæ (Calif.)
Shinglewood (Idaho)
Gigantic cedar (Calif.)
Cedar (Ore., Mont., Ida., Pacific Coast trade)
Gigantic red cedar (Calif., lit.)
Western cedar
Washington red cedar (trade)
Washington cedar (trade)
Idaho cedar (trade)
Oregon cedar (trade)

California cedar (trade)
British Columbia cedar (trade)
Pacific arborvitæ (lit.)
Western arborvitæ (lit.)
Western red cedar (trade)
Red cedar pine (trade)
Lobb's arborvitæ (Eng.)
Pacific red cedar (Calif., lit.)
Giant arborvitæ (lit., hort.)

Eastern Red Cedar:

Red cedar (N. H., Vt., Mass., R. I., N. Y., N. J., Pa., Del., Va., W. Va., N. C., S. C., Ga., Fla., Ala., Miss., La., Ky., Mo., Ill., Ind., Wis., Iowa, Mich., Minn., Ohio, Ontario, hort.)
Cedar (Conn., Pa., N. J., S. C., Ky., Ill., Iowa, Ohio)
Savin (Mass., R. I., N. Y., Pa., Minn.)
Juniper (N. Y., Pa.)
Juniper bush (Minn.)
Cedre (La.)
Eastern red cedar (trade)
Tennessee red cedar (trade)

Incense Cedar:

White cedar (Calif., Ore.)
Cedar (Calif., Ore., trade)
Incense cedar (Calif., Ore., trade)
Post cedar (Calif., Nev.)
Juniper (Nev.)
Bastard cedar (Calif., Wash.)
Red cedar (stop)
California post cedar (Calif., lit.)
California incense cedar (lit., hort.)
Roughbark cedar.

Description and Uses

Northern and Southern White Cedar:

Northern white and southern white cedar are often spoken of in the trade as white cedar. The bulk of the commercial supply of this lumber is cut from these two species. They have comparable structural features. Northern white cedar, however, is a somewhat smaller tree and never grows to as large a size as the southern white cedar. The wood of the northern white cedar is very light, soft, brash, aromatic, weak, fine-grained, fine-textured, with a light brown to pale brown colored heartwood; the sapwood is broad and is nearly white. It is not very strong, but is naturally resistant to decay.

Southern White Cedar:

Is pinkish in color, firmer, and more highly scented than northern white cedar.

Northern White Cedar:

Used principally for construction in the form of poles, posts, shingles, etc.

Southern White Cedar:

Used principally for boat and ship building, as well as for posts, poles, shingles, etc. A very small amount enters into the building and construction field as rough lumber.

Port Orford Cedar:

Is restricted in its distribution to the Pacific Northwest and has its best development in Oregon, which supplies the great bulk of this lumber for the trade. The wood has a somewhat brownish appearance, is firm and strong, and is highly scented.

A large amount is manufactured into siding, chests, closet-lining stock, shingles, rough construction—such as posts, poles, piling. A large quantity is also used for storage battery separators.

Yellow Cedar or Cypress:

The yellow cedar of the West Coast is often referred to as "yellow cypress" or "Alaskan yellow cedar," and is of the same genus as the southern white cedar. The tree is typically a West Coast species, its range extending from Alaska to California; considerable quantities of its timber are cut in Washington, which supplies the bulk of this lumber for commercial purposes. The wood is strongly aromatic, with a characteristic odor which is sometimes referred to as the odor of "rotten potatoes." The wood of the yellow cedar is perhaps the strongest of any of the cedars. It has a good figure and polishes well. It is much coarser-textured than southern white cedar, which it otherwise closely resembles. It is durable and can be used safely under conditions of extreme moisture.

It is used for practically the same purposes as southern white cedar. A large amount goes into the production of veneers used for paneling and built-up stock.

Western Red Cedar:

Is the largest and finest of any of the cedars. It is more or less confined to the Pacific Coast and appears to be restricted to wet and damp valleys in those regions in which atmospheric humidity is high. The wood is light, soft, brittle, aromatic, even-textured, and even-grained, and it is remarkably durable even when placed in contact with the soil. Its structure compares favorably with the eastern red cedar, except that it is coarser in texture It is entirely free from pitch, finishes well, has good nail holding qualities, and takes paint remarkably well. Because of its large size the logs yield wide, clear lumber that shows practically no tendency to warp or check. It is comparatively easy to kiln-dry and holds its shape well after being seasoned.

More than half the total cut is sawed into finished lumber and is used for planing mill products, with a somewhat smaller quantity going into ship building. A large amount is manufactured into bevel siding and shingles, which are noted for retaining their flatness and are said to last, when nailed with copper or zinc-coated nails, for from forty to fifty years. These shingles take and hold stain of the most delicate tint without discoloration. A large quantity of this timber is also used for rough construction in the form of piling, posts, poles, etc.

Eastern Red Cedar:

Is sometimes referred to as "pencil cedar," and obtains its best growth in rich, damp soils throughout the southern part of its range. Its best development is reached in Tennessee. The wood is light, aromatic, durable, and generally knotty. It is one of the few woods in

which such defects add to its value. The heartwood is purplish-red and the sapwood is pale yellow to white. It is fine-grained and fine-textured. The growth rings are uneven, with narrow summerwood bands. Eastern red cedar takes a high polish and is very pleasing when finished in its natural color.

At the present time there are a number of companies specializing in the manufacture of eastern red cedar into interior siding for use in moth-proof closets. Practically no eastern red cedar is used for rough construction purposes, inasmuch as the bulk of the cut is used for industrial purposes, such as chests, panels, and pencil stock, which, however, is now being supplanted by incense cedar.

Incense Cedar:

Is an important species in California and southern Oregon. The wood is soft, light, weak, very durable, and possesses a very pronounced peppery odor, which is characteristic of the species. It is somewhat similar in texture to eastern red cedar, for which it is used as a substitute to some extent in the manufacture of pencils. One of the common characteristics and defects of this tree is "peckyness," which is very similar to the same defect in cypress.

Incense cedar is used primarily for lath, shingles, posts, interior finish, etc. Its durability makes it a valuable wood for use where exposed to adverse weather and moisture conditions.

Classifications

For detailed information regarding grading rules, specifications, etc., consult:

Port Orford Cedar:

Cedar Grading Rules—Schedule M. 1925—Issued by Pacific Lumber Inspection Bureau.

Southern White Cedar:

Information on grade interpretations can be obtained from the Southeastern Forest Products Association. (No general rules are available, except those established by individual organizations, such as those of the Navy Department.)

Yellow Cedar:

Pacific Lumber Inspection Bureau—Schedule M. 1925.

Northern White Cedar:

Grading Rules for Northern White Cedar Lumber—Northern White Cedar Association. (Shingle grading rules are issued by the same Association.)

Western Red Cedar:

Standard Grading and Dressing Rules for Western Red Cedar—West Coast Lumbermen's Assn.

Rules for Grading Western Red Cedar Posts and Poles—Western Cedar Lumber Manufacturers Association.

Also, Western Pine Manufacturers Association.

Grading rules for red cedar shingles are available from West Coast Lumbermen's Association and from the Washington Oregon Shingle Association.

Eastern Red Cedar:

Rules for the Measurement and Inspection of Hardwood Lumber, Cypress, Veneers, Thin Lumber and Plywood (see rules indicated under "aromatic red cedar")—National Hardwood Lumber Association.

Incense Cedar:

Grading Rules for Cedar Lumber—California White and Sugar Pine Manufacturers Association and Western Pine Manufacturers Association.

(See general list of Associations for addresses.)

Types and Sizes

(Refer to Tables 6, 7, 8, 15, 16, 18.)

Unit Packages

Practically all cedar lumber is sold on a board foot basis. Plywood and veneers are sold on square foot basis. Cedar poles and posts are generally quoted and sold on lineal foot and unit piece basis.

Shipping Weights

The following approximate shipping weights are from figures given out by the various associations:

TABLE 110

Approximate Shipping Weights for Port Orford Cedar

Kind of Stock	*Lbs. per 1,000 Bd. Feet*		
	Rough Green	*Rough Dry*	*1S1, S2S, or S1S1E*
Timber	3300	....	3000
Lumber 2″ and 4″	3200	3000	2800
Lumber 2″	3300	3000	2600
Lumber 1″, 1¼″, 1½″	3300	2800	2400
1″, 1¼″, 1½″, rough, resawed	....	2700	....
1″, 1¼″, 1½″, rough, resawed twice	....	2600	....
1″, 1¼″, 1½″, S2S and resawed	....	....	2300
1″, 1¼″, 1½″, resawed and S2S afterwards	....	....	2200
2″, resawed twice	....	2800	....
⅜″ panel stock	....	....	1000
½″ panel stock	....	....	1200
⅝″ panel stock	....	....	1400
¾″ panel stock	....	....	1800
Worked flooring, partition dropsiding, and shiplap	....	....	2000
Molded casing and base	....	....	1800
⅜″ ceiling	....	....	1000
½″ ceiling	....	....	1200
⅝″ ceiling	....	....	1400
12″ bevel siding	....	....	700
Lath ⅜″	....	....	500
Byrkits sheathing	....	....	1500
Moldings	Approximate weight of moldings 1 x 1, per 100 lin. ft., 15 lbs.		

TABLE 111

Approximate Shipping Weights for Western Red Cedar

Kind of Stock	*Lbs. per 1,000 Board Feet*
Bevel siding	700
Bungalow siding ½"	700
Bungalow siding ¾"	1000
Boards, S1S, or S2S	2200
rough dry	2700
rough green	3000
Finish 1" S2S	1800
1¼", 1½" and 2" S2S	2000
rough dry	2700
rough green	3000
Porch Flooring	1600
Turning Squares, S4S	2000
rough dry	2700
rough green	3000
Timbers, S4S	2500
rough	3000

TABLE 112

Approximate Shipping Weights for Incense Cedar

Kind of Stock	*Lbs. per 1,000 Board Feet*
Rough	2300
Pencil stock	2200
S2S or S4S	2000

Shipping weights for other cedars can be obtained from associations handling these species.

Ordering

In purchasing cedar lumber, either rough or patterned stock, follow general instructions under Ordering.

In the purchase of shingles, poles, posts, piling, etc., definite specifications as to the species desired, size, etc., should be stated, noting particularly for poles and posts the piling diameters and lengths. In piling, small and large diameters should be indicated; also full specifications of stock required.

Caution

Attention is called to grading rules and interpretations relative to the various species of cedar.

Eastern red cedar (aromatic cedar) is graded under hardwood grading rules, while the other cedars are graded as softwoods.

Special Service Requirements

The cedars vary greatly in their respective properties. Some are considered specialty woods and are admirably suited for certain specific uses.

The outstanding properties of the cedars are their natural durability and resistance to decay. Considerable variations exist in the qualities, sizes, and availability of the different

species of the cedars. Western red cedar, which is the leader according to production figures and consumption, is available in practically all of the important consuming areas in the United States, in a wide range of grades and products.

All of the cedars are soft, and are ideal for fabrication and working.

Specifications

The following may be consulted for information on specifications:

Lumber-Simplified Practice Recommendation—Bureau of Standards.
Standards and Specifications in the Wood-Using Industries—Bureau of Standards.
National Directory of Commodity Specifications—Bureau of Standards.

(See general Bibliography for publishers' addresses.)

Engineering Data

(See Table 2.)

Improvements

The commercial production of cedar lumber has greatly increased in the last few years. Associations have developed new uses for the cedars, have specialized in the quality of the lumber produced, and have established grades in accordance with American Lumber Standards. Extensive research in regard to the properties of the cedars has pointed out many specific uses for which these species especially fill the requirements.

Associations

The following organizations will be glad to give information regarding lumber and other stock cut from the cedars:

Port Orford Cedar:
Port Orford Cedar Products Company, Marshfield, Oregon.
West Coast Lumbermen's Association.

White Cedars: (southern and northern)
Northern White Cedar Association.
Southeastern Forest Products Association

Yellow Cedar (or cypress):
West Coast Lumbermen's Association.

Western Red Cedar:
West Coast Lumbermen's Association.
Western Red Cedar Association.
Western Pine Manufacturer's Association.

Eastern Red Cedar:
National Hardwood Lumber Association.

Incense Cedar:
California White and Sugar Pine Association.
Western Pine Manufacturers Association.

(See general list of Associations for addresses.)

Publications

The following publications frequently carry trade items regarding prices, etc., of the cedars:

Western Cedars (Port Orford, yellow (or cypress), western red, and incense):

American Builder
American Lumberman
Crow's Pacific Coast Lumber Digest
Four L Lumber News
Lumber Trade Journal
New York Lumber Trade Journal, The
Timberman, The
West Coast Lumberman
Western Retail Lumberman
Western Wood Worker and Furniture Manufacturer
Wood Construction

Eastern Cedars (northern white, southern white, and eastern red):

American Lumberman
Gulf Coast Lumberman
National Lumberman
Lumber Trade Journal
New York Lumber Trade Journal, The
Mississippi Valley Lumberman
Southern Lumberman
Wood-Worker, The
Wood Working Industries

(See general list of Periodicals for publishers' addresses.)

Bibliography

The following books and articles may prove helpful to readers desiring further information:

PORT ORFORD CEDAR:

Port Orford Cedar—Its Properties and Uses—Port Orford Cedar Products Co.

"Port Orford Cedar—Characteristics and Uses"—*The Lumber and Veneer Consumer*, Oct. 30, 1921.

"Uses for Port Orford Cedar"—H. H. SMITH—*Hardwood Record*, Chicago, Ill., Dec. 10, 1913.

SOUTHERN WHITE CEDAR:

American Forest Trees—H. H. GIBSON.

YELLOW CEDAR (or cypress):

Uses of Commercial Woods in the United States—Cedars, Cypresses, and Sequoias—W. R. HALL and HU MAXWELL.

NORTHERN WHITE CEDAR:

"White Cedar or Arborvitæ"—*Hardwood Record*, Chicago, Ill., Aug. 25, 1907.

Uses of Commercial Woods in the United States—Cedars, Cypresses, and Sequoias—W. R. HALL and HU MAXWELL.

WESTERN RED CEDAR:

"Western Red Cedar in the Pacific Northwest"—J. B. KNAPP and H. G. JACKSON—*West Coast Lumberman*, March 1, 1914.

Forest Trees of the Pacific Slope—GEORGE B. SUDWORTH.

"Western Red Cedar"—Forest Service Leaflet—*American Wood Series.*

(Attention is also called to various publications issued by the West Coast Lumbermen's Association dealing with the properties and uses of western red cedar.)

EASTERN RED CEDAR:

Eastern Red Cedar—Forest Service Leaflet, American Wood Series.

"Tennessee Red Cedar"—L. E. BROWN—*The Southern Lumberman*, Nashville, Tenn., Dec. 21, 1912.

INCENSE CEDAR:

Incense Cedar—J. ALFRED MITCHELL.

Incense Cedar—Forest Service Leaflet—American Woods Series.

(See general Bibliography and list of Periodicals for publishers' addresses.)

Abbreviations and Terminology

P.O. cedar—Port Orford cedar
S.W. cedar—Southern white cedar
N.W. cedar—Northern white cedar
W.R. cedar—Western red cedar
E.R. cedar—Eastern red cedar

(See general list of Abbreviations and Glossary.)

THE SOUTHERN CYPRESS[1]

(A Softwood)

Taxodium distichum

ANNUAL PRODUCTION (1928) ..... 501,422,000 bd. ft.
AVERAGE VALUE OF LUMBER CUT AT MILL PER M.B.F. (1928) $36.18
TIMBER STAND (1920) ..... 22,921,000,000 bd. ft.

PRINCIPAL STATES PRODUCING CUT—IN ORDER OF IMPORTANCE (1928):

Louisiana, Florida, South Carolina, Arkansas, Mississippi, Georgia, North Carolina, Missouri.

Range of Species

From southern Delaware southward to the Coast region to southern Florida; westward in the Gulf Coast region to Texas; and northward through Louisiana to Oklahoma, Arkansas, northern and western Mississippi and Tennessee, southeastern Missouri, western Kentucky, southern Illinois, and southwestern Indiana.

Usual Name

The lumber called cypress in the United States is a product of the American bald cypress (Taxodium distichum).

Also Called

Tidewater red cypress (trade)
Louisiana red cypress (trade)
Gulf red cypress (trade)
Gulf Coast red cypress (trade)
Bald cypress (Del., N. C., S. C., Ala., La., Fla., Tex., Ark., Mo., Ill., Ind., and hort.) (trade)
White cypress (N. C., S. C., Ala., Tex., Miss., Ark., Tenn., trade)
Red cypress (Fla., Ga., Miss., La., S. C., Tex., trade, Coast type)
Swamp cypress (La., Fla., trade)
Cypress (Del., N. C., Tenn., S. C., Fla., Miss., Ky., Mo., Ill., trade)
Deciduous cypress (Del., Ill., Tex.)
Southern cypress (Ala. and trade)
Black cypress (N. C., Fla.)
Cow cypress (N. C.)
River cypress (lit.)

[1] American Lumber Standards have designated cypress under the following commercial classifications:
Red cypress (Coast type), Taxodium distichum
Yellow cypress (inland type), Taxodium distichum
White cypress (inland type), Taxodium distichum

Gulf cypress (trade)
Yellow cypress (Miss., Ark., Tenn., N. C., S. C., trade)
White livered cypress (N. C., S. C.)
Common bald cypress (inland type)

According to the *Check List of the Forest Trees of the United States, their Names and Ranges*, by George B. Sudworth, there are many varieties of cypress, but there is only one true distinct species; namely, as noted above, Taxodium distichum.

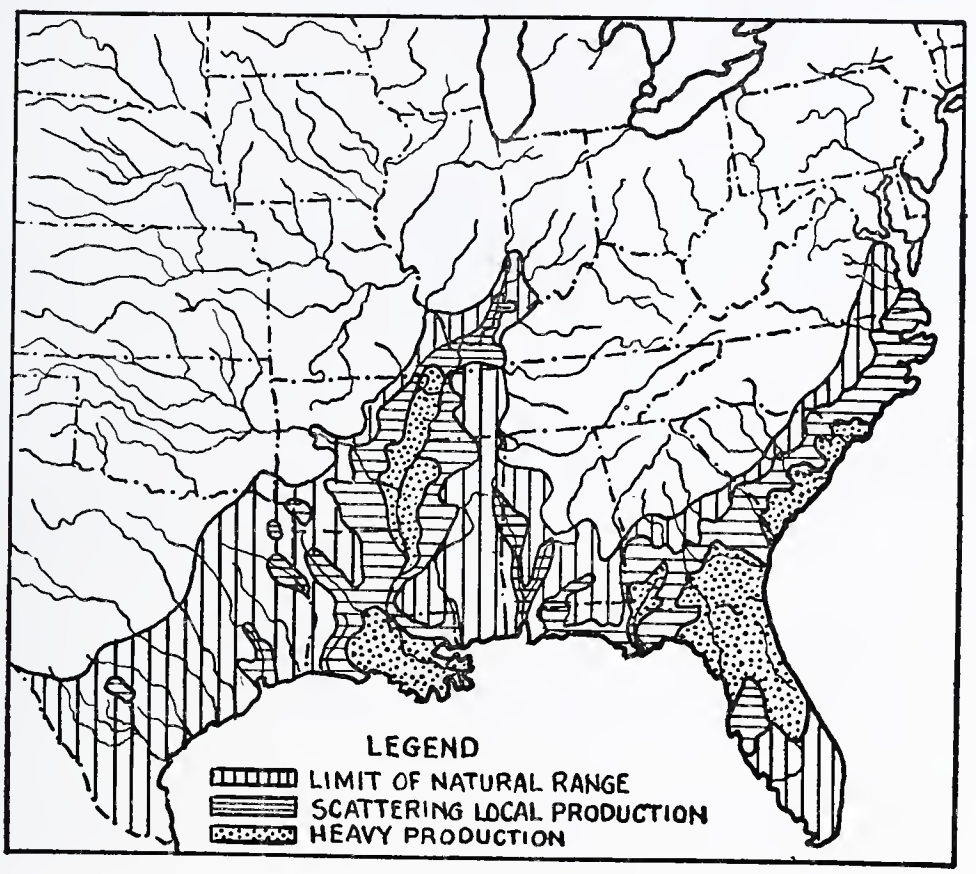


Illustration 47—General range of cypress.

However, within this species a variety has developed which has led to considerable discussion and differences of opinion. This refers to the so-called "inland type" and the "coast type."

According to the botanists (U. S. Dept. of Agriculture) the concensus of opinion separates Taxodium into two distinct and separate species; namely, Taxodium distichum (Coast type), and Taxodium adscendens (inland type).

The U. S. Department of Agriculture says,

> Because of variations in leaves, leaf forms, and structure, form of the trees, and differences in the wood itself (color), it is most advisable to separate the species as noted above.

The Forest Service [1] only recognized one species—Taxodium distichum—and believes from its investigations that the Taxodium adscendens species is only a variety of the true Taxodium distichum which is brought about by changes in climate and other environmental factors which create variations in the growth of the tree.

[1] *The Southern Cypress*—Wilbur R. Mattoon.

The Forest Service states,

Though preeminently a tree of the swamp, when planted it thrives in as wide a range of climate and soil as most of our forest trees. . . . Because of its power to develop special organs or parts, cypress possesses unusual ability to adapt itself to conditions of soil and water generally considered extremely unfavorable to tree growth. As a result, the tree occurs in various forms differing widely in respect to leaf, bark, shape, size, and to a limited extent in wood characteristics.

Recent investigation has shown that there are some minor differences in the characteristics of the wood and difference in rate of growth. There are indications that the varietal form (var. imbricarium), which is more abundant over the Atlantic coastal plain, is undergoing a gradual botanical segregation. . . .[1]

Evidence points clearly to soil conditions, particularly acidity and drainage, as fundamental factors causing the botanical varieties of cypress.

The range of the imbricate form, so far as known at present, is generally coincident with the limits of the Atlantic coastal plain, and extends southward into northern Florida and westward to Alabama. The main species, on the other hand, finds its most congenial home along the Gulf Coast and along the Mississippi Valley in the damp alluvial soils.

Description

For all practical purposes in this discussion the nomenclature of cypress refers to the true species, Taxodium distichum, tidewater red cypress (coast type), while the variety refers to Taxodium distichum var. imbricarium (Forest Service), Taxodium adscendens (U. S. Department of Agriculture—botanically), inland cypress (inland type).

The members of the Southern Cypress Manufacturers Association, in order to specify to the trade the variation within the species, have accepted the trade name "Tidewater red cypress" as applying to true cypress (Taxodium distichum).

It is generally admitted that the tidewater red cypress is a superior wood to the inland variety, and has certain very definite and individual characteristics. These properties are briefly summed up in Table 113.

TABLE 113

Tidewater Red Cypress (*Taxodium distichum*) Coast type	Inland Cypress (White or Yellow) (*Taxodium distichum var. imbricarium*) Inland type
Durability	
One of the most durable American woods Heartwood is particularly resistant to fungi attack	Considered not quite as durable
Color	
Varies from slightly reddish to a deeper red—almost black (The darker the wood the more durable it is)	Yellow, whitish, with sometimes a pinkish cast
Sapwood	
Sapwood ring very narrow	Sapwood wide
Weight	
Green, 50 to 60 lbs. per cu. ft. Dry, 28½ lbs. per cu. ft.	Said to be slightly lighter
Shrinkage	
Green to bone dry—8% in volume The following figures indicate the shrinkage from green to oven-dry condition, based on dimensions when green, the specific gravity of dry wood as .45, and the weight per M. ft. of kiln-dry wood at 5% moisture as 2460 lbs.: A—volume 11.5% B—radial 3.8% C—tangential 6.0%	
Strength	
(See Table 2.)	

[1] *The Southern Cypress*—Wilbur R. Mattoon.

Because of its many favorable properties cypress has for years been used extensively for construction purposes.

The grain is straight; the lumber is available in large dimensions; it is easy to work; and the heartwood is very resistant to decay. Its strength and weight are about midway between the heavy pines and the light pines. Its surface shows a decided oily or waxy appearance and the wood has a rancid odor, especially when green. The wood is resistant to changes in moisture, and is therefore of great value for use where exposed to moisture conditions. It imparts neither color nor taste. Its resistance to acid is marked and it has been used extensively as a tank material. Cypress is frequently sand-blasted, resulting in a pleasing effect. Its grain is enhanced greatly by natural finishes, but it also will take and hold paint remarkably well.

Cypress is quite commonly affected by what is known as "peck." Peckiness is a peculiar type of decay, common to incense cedar and cypress, and it appears in the wood as small, decayed areas in which the substance becomes brittle before it finally becomes powdery and disappears. The borders of these decayed areas are sharply defined, while the wood outside them is in no way injured. Consequently, such a form of decay may be considered as injuring only the strength of the wood, since it eliminates a certain volume of the tissue. Peckiness is said, on the other hand, to increase the resistance of the wood to further decay. Pecky cypress is used for many purposes. At present it is extensively employed as a decorative wood for interior uses, in the form of paneling and beams. It is used also for sills and foundations.

Uses

For the sake of ready reference, the uses of cypress have been grouped under the following headings, followed by a list of commodity products:

- Structural timbers and rough carpentry
  - heavy and light dimension
  - rough lumber
  - common boards, etc.
- Shingles
- Siding
  - bevel siding
  - bungalow siding
  - drop siding
  - shiplap
- Exterior mill work
  - window and door frames, sash
  - exterior cornices
  - half timber work
  - porch ceilings
  - shutters and blinds
  - porch flooring
  - columns
- Interior millwork
  - finish
  - trim (molding)
  - cornices and beams
  - wood sash
  - panels
  - wood doors (stiles and rails)
  - wainscoting and paneling
- Flooring for interior use
  - factory flooring
  - finish, corner boards, and dimension
- Miscellaneous
  - factory lumber (tank and boat stock)
  - heavy roofing
  - decking, sheet piling, pickets, batteries
  - turning squares, switch ties, cross ties
  - car roofing and siding, car lining
  - washing machine tub stock, veneers, plywood

Classifications

For detailed information regarding specifications, classifications, grading rules, etc., consult:

Standard Grades and Classifications of Cypress—Southern Cypress Manufacturers Association.

Rules for the Measurement and Inspection of Hardwood Lumber, Cypress, Veneers, Thin Lumber, and Plywood—The National Hardwood Lumber Association. Rules for grading and measurement of cypress.

(See general list of Associations for addresses.)

Types and Sizes

The following grades and sizes of cypress refer to lumber produced for industrial uses, and indicate those which are most commonly cut and consumed by manufacturers and fabricators. The stock is available either air-dried or kiln-dried and is carried in stock by representative mills in producing regions (for types and sizes of yard and factory lumber refer to Tables 6, 7, 8, 9, 16 and 18.

TABLE 114

Tank cypress	12/4	(10′–24′ long)					
FAS	3/4	5/8	4/4	5/4	6/4	8/4	12/4
Select	4/4	5/4	6/4	8/4	10/4	12/4	
No. 2 Shop	4/4	5/4	6/4	8/4	10/4		
No. 1 Common	4/4	5/4	6/4				
No. 2 Common	4/4	5/4	6/4				
No. 3 Common	4/4	5/4					
Pecky	4/4						

Cypress is available either in the rough or surfaced. Note particularly the hardwood grading rules for surfaced stock. Refer also to surfaced thickness for yard lumber and factory lumber. (Tables 7, 8, 15.)

Unit Packages

Factory lumber is sold on the basis of 1,000 bd. ft. measure; random lengths and widths.

TABLE 115

Thickness Nominal Rough	*Thickness Finished (S1S or S2S)*
3/8″	3/16″
1/2	5/16
5/8	7/16
3/4	9/16
1	13/16
1 1/4	1 1/8
1 1/2	1 3/8
2	1 13/16
2 1/2	2 5/16
3	2 3/4
4	3 3/4

Yard lumber is sold on the basis of 1,000 bd. ft. measure; widths (see Table 7), lengths, 8–10 ft.

TABLE 116

Thickness Nominal Rough	*Thickness Finished (S1S or S2S)*
	5/16″
	7/16
	9/16
	11/16
	13/16
1 1/4″	1 1/16
1 1/2	1 5/16
2	1 3/4
2 1/2	2 1/8
3	2 5/8
4	3 5/8

SIDING, FLOORING, MILLWORK ETC.: Sold on board foot basis, based on actual measurements before machining.

MOLDING, ETC.: Sold on lineal foot basis.

HEAVY TIMBER AND DIMENSION: Sold on basis of 1,000 board feet measure.

SHINGLES: Sold as dimension shingles, and also random widths. 4,000 lineal inches constitute 1,000 shingles. For grading rules, specifications, and sizes consult Grading Rules for Shingles.

VENEERS: Sold on square foot basis. Consult *Rules for the Measurement and Inspection of Hardward Lumber, Cypress, Veneers, Thin Lumber, and Plywood.*

Shipping Weights

The following table gives approximate shipping weights for cypress lumber:

TABLE 117

WEIGHTS OF TIDEWATER RED CYPRESS

	Pounds per M.		
	Green	*Rough Dry*	*S1S or S2S Dry*
Lumber 4″	5,000	3,500	3,200
Lumber 2½″ and 3″	5,000	3,500	2,900
Lumber 2″	5,000	3,200	2,600
Lumber, 1½″, 1¼″ and 1″	5,000	3,000	2,400
1″ Lumber, Rough, Resawed	....	2,800	....
1″ Lumber, Rough, Resawed twice	....	2,700	....
1″ Lumber, S2S and Resawed	....	....	2,250
1″Lumber, Resawed and S2S afterwards	....	....	2,000
2″ Lumber, Rough, Resawed twice	....	2,800	....
⅜″ Panel Stock			800
½″ Panel Stock			1,000
⅝″ Panel Stock			1,400
¾″ Panel Stock			1,600
Worked Flooring, Partition, Drop Siding, Shiplap, Molded Casing and Base			2,200
⅝″ Ceiling			1,600
½″ Ceiling			1,300
⅜″ Ceiling			1,000
½″ Bevel Siding			1,000
⅝″ Bungalow Siding (from 5/4″)			1,400
¾″ Bungalow Siding (from 6/4″)			1,850
Shingles, all grades			300
Lath, ⅜″			500
Lath, ⅝″			900
Byrkit's Sheathing Lath			1,500

Ordering

Specify Clearly:

Whether coast type or inland type of cypress is preferred

Definite quantity needed—1,000 board feet, lineal feet, or square feet, or bundles (shingles), depending on how the commodity is sold

Thickness

Moisture content (kiln-dried, air-dried, etc., and preferred moisture content)

In cases of machined or worked material—thickness, surfacing, etc.

Whether yard lumber is wanted (i.e., finish, common lumber, panel stock, etc.), factory lumber, or timber and railroad material, etc.

Shipping instructions; data of delivery

Caution

Yard lumber is factory lumber.

Cypress lumber is cut for two definite uses: structural and industrial. For the first, yard lumber is generally used. It is cut to a definite width, thickness, and length, and is usually intended for use in the "whole" (appearance is important). Factory lumber is cut random width. It is intended for recutting into clear face cuttings and for further fabrication. Therefore, clearly ascertain as to whether the specifications on an order will serve the purpose.

Watch for excessive peckiness, small pin knots, etc. They may be in excess of amounts allowed in the grading rules.

Watch for heavy lumber in incoming shipments, particularly if there seems to be a wide range in moisture content.

Ascertain if material complies with specifications indicated on order.

Check footage, number of pieces or bundles, etc.

See that grades, thicknesses, and proportionate amount of long lengths are contained in shipment (consult *Rules for the Measurement and Inspection of Hardwood Lumber, Cypress, Veneers, Thin Lumber, and Plywood*).

Watch for excessive sapwood.

Special Service Requirements

Determine specifically whether the material ordered will efficiently answer the desired use, with particular reference to the following requirements.

For some purposes long length stock is required. This must be specified as usual.

In ordering special dimension and heavy dimension exact information is required as to rough or finished sizes (thickness, width, and length), especially if the stock is to be cut to order at mill.

For exposed use the heartwood is more resistant to decay. (Cypress is one of our most resistant woods.) The sapwood can be used for interior purposes. It may be necessary to specify "all heartwood" in some instances. For tank stock, used for chemical tank purposes, cypress is particularly well adapted. Specify whether the stock is to be used for this purpose and if so "all heartwood" is required.

Industrial uses sometimes require a lower moisture content than is needed for yard lumber. For kiln-dried stock specify exact moisture content required; for air-dried stock, state approximate moisture content desired.

Pecky cypress can be used for many purposes. It is much cheaper than sound stock.

Specifications

The following publications may be consulted for information regarding specifications for cypress:

Lumber—Simplified Practice Recommendation—Bureau of Standards.

National Directory of Commodity Specifications—Bureau of Standards.

Standards and Specifications in the Wood-Using Industries—Bureau of Standards.

(See general Bibliography for publishers' addresses.)

Engineering Data

(See Table 2.)

Improvements

Manufacturers of cypress lumber constantly are striving to give to the consumers lumber and stock which is as nearly perfect as possible as to cutting and fabrication; also,

To use types of machinery which will produce a higher quality of stock

To give to the ultimate consumer stock carefully inspected

To comply with the grades as specified

To distribute stock containing the specified moisture content (eliminating wide ranges of moisture contents in shipments)

To conform to American Lumber Standards

To develop new uses for this species if possible

To furnish grade-marked, trade-marked lumber

To furnish shippers' certificate of car contents

Associations

The following associations will be glad to give information regarding cypress lumber and materials:

National Lumber Manufacturers Association.
Southern Cypress Manufacturers Association.
National Hardwood Lumber Association.
Hardwood Manufacturers Institute.

(See general list of Associations for addresses.)

Publications

The following publications frequently carry trade items regarding cypress stock, prices, and other data:

American Builder
American Lumberman
American Woodworking Review
Gulf Coast Lumberman
Lumber Co-Operator
Lumber Trade Journal
Millwork
Mississippi Valley Lumberman
National Lumberman
National Retail Lumber Dealer
New York Lumber Trade Journal, The
Retail Lumberman
Retail Lumber Trade News
Southern Lumberman
Veneers
Wood Workers Clearing House Journal
Wood Construction
Wood Preserving News
Wood-Worker, The
Wood Working Industries

(See general list of Periodicals for publishers' addresses.)

Bibliography

The following books and articles may prove helpful to readers desiring further information:

Lumber and Its Uses—R. S. Kellogg.
American Forest Trees—Henry H. Gibson.
The Southern Cypress—Wilbur R. Mattoon.
Check List of the Forest Trees of the United States, Their Names and Ranges—George B. Sudworth.
Specification Data for Structural Uses of Tidewater Red Cypress (Coast Type)—Southern Cypress Manufacturers Association.
"Tidewater Red Cypress—Yesterday, Today, and Tomorrow"—Benjamin R. Ellis—*Southern Lumberman*, Dec. 22, 1928.
American Forests and Forest Products—Statistical Bull. No. 21, Forest Service.

(See general Bibliography and general list of Periodicals for publishers' addresses.)

Abbreviations and Terminology

Pecky—(See discussion under Description.)
Cyp.—cypress
P. Cyp.—pecky cypress

(See general list of Abbreviations and Glossary.)

DOUGLAS FIR

(A Softwood)

Pseudotsuga taxifolia

Annual Production (1928) ..... 8,449,298,000 bd. ft.
Average Value of Lumber Cut at Mill per M.B.F. (1928) $19.02
Timber Stand (1920) ..... 595,505,000 000 bd. ft.

Principal States Producing Cut—in Order of Importance:

Washington, Oregon, California, Nevada, Montana, New Mexico.

Range of Species

Rocky Mountain region in the United States; northward to Central British Columbia; westward to Pacific Coast; southward into northern Mexico, and mountains of west Texas.

Usual Name

Douglas fir

Also Called

Red fir (Ore., Wash., Idaho, Utah, Mont., Colo., and trade)
Douglas spruce (Cal., Colo., Mont.)
Douglas fir (Utah, Ore., Colo.)
Yellow fir (Ore., Mont., Idaho, Wash., and trade)
Spruce (Mont.)
Fir (Mont., and trade)
Oregon pine (Utah, Idaho, Colo.)
Red pine (Utah, Idaho, Colo.)
Puget Sound pine (Wash.)
Douglas-tree
Cork-barked Douglas spruce (var. suberosa Lemmon)
Red spruce (Colo.)
Douglas yellow fir (trade)
Oregon fir (trade)
Pacific Coast Douglas fir (trade)
Montana fir (trade)
National yellow fir (trade)
Goldenrod Douglas fir (trade)
Yellow Douglas fir (trade)
"Santiam" quality fir (trade)

Description

According to the United States Forest Service, fully 50 per cent of the standing timber in this country is found west of the Great Plains. Of this amount, over 50 per cent from the

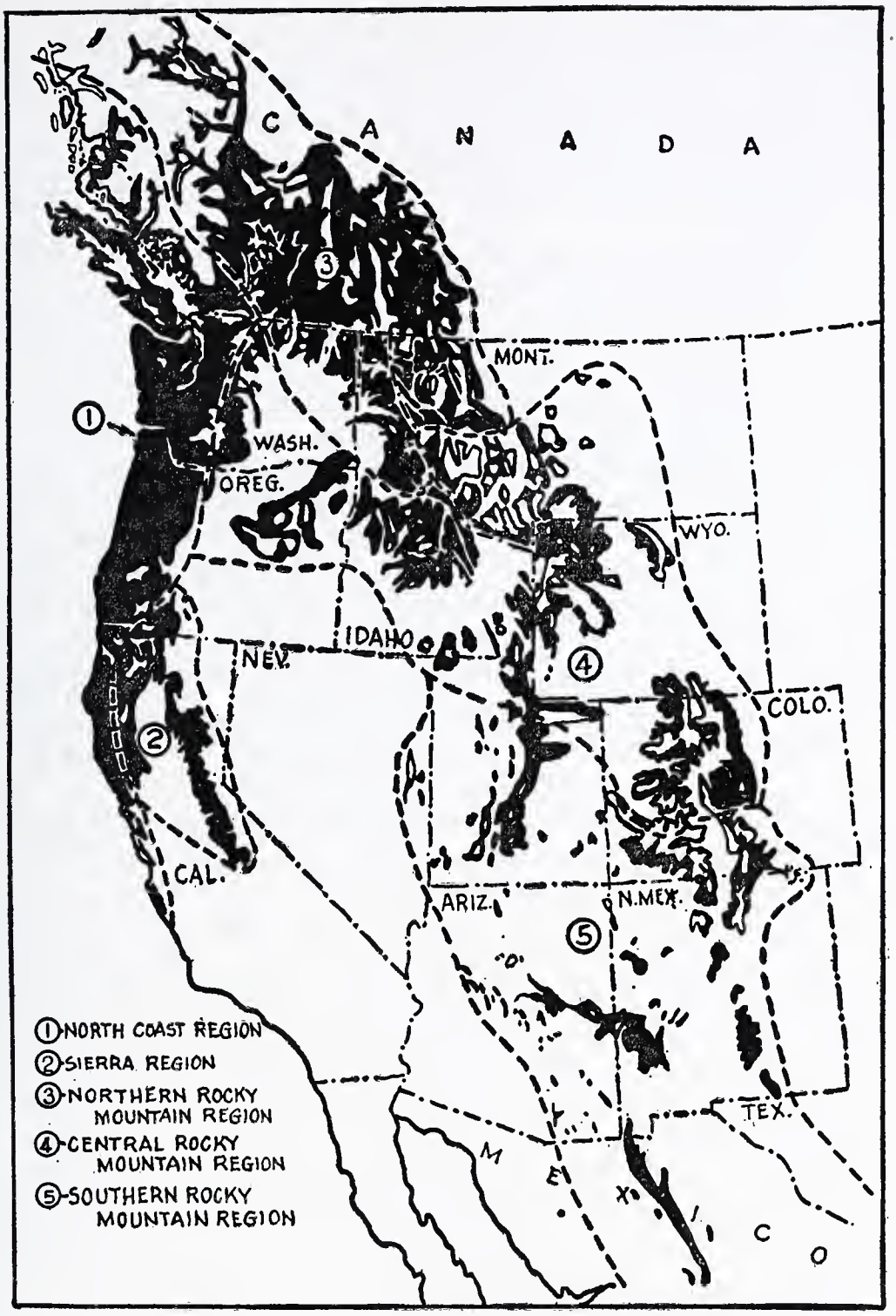


Illustration 48—Five regions constituting the general range of Douglas fir.

Rocky Mountains west is located in the so-called Douglas fir regions in Washington and Oregon. Douglas fir composes approximately 70 per cent of the stand. The remainder consists of:

West Coast hemlock	15%
Western red cedar	10%
Sitka spruce	1.5%

and small quantities of Port Orford cedar, Noble fir, white fir, and other species of true firs.

Douglas fir was named for David Douglas, the first professional botanist to visit the northwest forest region, in 1825. It is not a true fir, or a pine (called Oregon pine in export markets), or spruce, as it has often been named. Botanically, it is a separate species and represents commercially the sole representative of a genus of the American Continent—Pseudo tsuga (false hemlock).

The commercial name of this species is Douglas fir, and its scientific nomenclature is Pseudotsuga taxifolia.

Old-growth Douglas fir in the forest attains an average diameter of 5 or 6 feet and a height of 200 or more feet.

It grows under various conditions of soil, climate, altitude, and exposure, and because of the mountainous character of the Douglas fir forest lands there is within a comparatively small area a variety of soil and altitude—from the level plains of the valley or "draw," to the crest of the ridge, and various exposures on opposite sides of the main ranges and lateral spurs. This condition makes desirable the sorting of logs for type, in order to obtain uniformity in the lumber sawed for various purposes.

Douglas fir may be divided broadly into several types. The types vary somewhat with locality, particularly with regard to broad divisions of region.

In the typical old-growth tree, measuring from two feet up to six or eight feet in diameter, the wood is usually red at the center and yellow at the outside, the two colors merging in the wood of medium rate of growth. In greatest contrast to this type of log is the small yellow fir, a tree that may not exceed 24 to 30 inches in diameter. The wood of this tree is close-grained and of uniform rate of growth entirely across the section. Between these two types is the large red fir, a tree that grows to a diameter of 48 to 60 inches. It is coarser in grain than the small yellow fir, but of the same uniform rate of growth, and, because of the more rapid growth, is of red wood throughout.

Douglas fir is produced from logs that vary greatly in dimensions. Logs from 6 to 12 feet, and even larger than this, come to the mills. Much smaller timber is also logged.

Material cut from smaller, rapidly growing trees, or from thrifty trees of fairly large dimensions, is usually marketed in the form of timbers or common lumber. The wood from such logs is usually of a light, orange-red color when cut, and as it ages, under cover, it assumes a darker, reddish-brown hue. When exposed to the weather, it passes through color phases depending upon conditions of exposure and climate, but invariably it weathers to a soft, neutral rather reddish-gray.

The outer portion of large logs yields a fine-grained wood that, when freshly cut, is a very light ochre, faintly tinged with orange. Such wood is (colloquially) called "yellow" fir, as distinguished from the "red" fir produced by rapidly growing trees. When "yellow" fir ages, it darkens to a soft, light burnt umber with a somewhat reddish cast. Upon exposure to the weather, it passes through the same color phases as "red" fir, but the final color is a much lighter, pleasing, soft reddish-gray. The best grades of finish lumber are cut from this wood.

Slash grain Douglas fir presents a very striking figure, and when properly controlled this figure can be toned with beautiful results. Vertical grain Douglas fir, which can be supplied in wide widths, offers a subdued pattern. Combinations of slash grain Douglas fir plywood panels with trim of vertical grain material can be made with most excellent results.

The forester can find practically no difference between red fir and yellow fir, except

in rate of growth; rapidly grown wood is red, and slowly grown wood, yellow. In red fir and yellow fir of equal specific gravity, the Forest Products Laboratory does not find enough variation in strength to say that one or the other is the stronger.

Based upon the rate of growth, the wood structure of the Douglas fir consequently can be classified under three types: The medium-grained wood of the structural type; the coarser-grained wood of the center of the rapidly grown tree; and the fine-grained, soft, old-growth wood.

There is, therefore, the same variety of type in Douglas fir that there is in southern pine, and in each species of southern pines; but it is all Douglas fir, and there are no distinguishing names of varieties by which to identify the different types. Furthermore, by contrast, the logging which is carried on in the South (in the southern pine region) is confined to more or less level land, instead of the rough ranges over which logging is executed in the West. The result is that, growing at a uniform altitude and under uniform exposure to sun and wind, a stand of timber in the South will show great uniformity from year to year, through many years of cutting; while the West Coast timber varies from draw to ridge, and from north slope to south slope, and the same camp often logs several types of timber in the course of a year.

The West Coast has not been accustomed to make the distinction in types that the South has long made under the designations of "longleaf" and "shortleaf" pine, and the result is a feeling in the East that there is more variability in West Coast woods than in southern woods. This will be overcome by segregation of the types, and this is now being done at some mills.

One of the distinctive features of Douglas fir is its thin ring of sapwood, averaging not more than four inches thick in a 48-inch log. This makes it easy to get structural timbers of 100 per cent heart face, and it is unlikely that they will have any great amount of sap, because the sapwood is more valuable in clear cuttings, and timber would usually be cut entirely inside the sap.

The heartwood is far more durable than the sapwood, and this feature of Douglas fir is one which makes it of great value where durability is important.

The methods of manufacturing fir "shop" result in a large proportion of vertical grain lumber. The Douglas fir log is not of the type from which "shop" grades can be cut as in other "shop" species, but with the development of resaws and gangs, the manufacturer has found that he could go deep into his log with thick cants and resaw them to vertical grain "shop" of greater value than flat grain. Vertical grain "shop" lumber finishes smoothly and will not show small checks or raise when exposed to the weather, as in the case of flat-grained pieces.

The suitability of Douglas fir for various uses is largely associated with its rate of growth. In a large, typical, old-growth tree the growth is rapid at first, becoming slower and slower as the tree increases in age and size, with a corresponding uniform change in grain, from coarse at the center, to very fine at the surface. The coarse-grained wood of the heart of this tree is suitable for general uses such as boards, studs, and joists. The wood of medium or normal rate of growth is hard, tough, and strong, and is used for structural purposes. The fine-grained wood of the outer part of the tree is soft, of uniform texture, and works easily. In smaller trees the rate of growth is more uniform. The wood of these trees is sometimes of the structural type throughout, and sometimes, in fast-growing trees, of the coarse type.

Douglas fir is one of the strongest woods, pound for pound, that has been tested. The color ranges, as mentioned above, from red to yellow. Likewise, there is a pronounced variation in the texture of the wood. It is quite resistant to decay, but for use in extreme conditions it is treated. Frequently the expression is heard that the wood is brittle and hard to work. This is undoubtedly unfounded, as with the increased distribution and use of the wood these prejudices are being overcome. It kiln-dries very easily and holds its shape. The flat grain is often figured and offers an attractive surface, due to contrast of springwood and summerwood. This is made use of in sand-blasting for panels, doors, etc. Although the wood contains scattered resin ducts and pitch pockets, it is not considered as a resinous wood. When green the wood has a characteristic odor which lessens with age. It naturally takes stain and finish well.

Uses

Douglas fir and southern yellow pine represent our most important structural woods. It is said that 2,500 items are now being made from Douglas fir. The following list of uses represents those which are outstanding:

Building and construction
- structural timbers
- dimension, studding, posts, rafters, etc.
- millwork
  - interior and exterior
    - window, sash, doors, etc.
    - panels, trim

Mill construction
- framing
- decking
- flooring, etc.

Industrial uses
- shipbuilding
  - spars, keels, stems
  - planking, stringers
  - frames, bulkheads
  - knees, strakes
  - decking, etc.

Dock and wharf
- sheet piling, poles, piles
- decking, etc.

Bridges and heavy trusses
- long-length dimension

Railroad
- car construction
- cross ties
- bridge timbers, lumber, etc.

Miscellaneous
- plywood and veneers
- wood pipe and staves
- ladder stock
- cross arms
- body-framing stock (automotive)
- furniture stock
- fixtures
- box and crate stock
- mine timber, baggage, etc.
- paving blocks, etc.

Classifications

For detailed information regarding types, grades, etc., with reference to qualities and uses, consult:

Standard Grading and Dressing Rules for Douglas Fir, Sitka Spruce, West Coast Hemlock, and Western Red Cedar Lumber—West Coast Lumbermen's Association.

The West Coast Lumbermen's Association will inspect at mill and reinspect at point of unloading, only on Standard Grading and Dressing Rules No. 9, dated July 1, 1929. Lumber sold under No. 9 Rules as to grade, but of sizes other than those specified therein, will be inspected and reinspected as coming under special contract. See also

Standard Grading Rules for Pondosa Pine, California White Pine, Sugar Pine, Idaho White Pine, Larch, Douglas Fir, White Fir, Spruce and Cedar Lumber. Published jointly by Western Pine Manufacturers Association and California White and Sugar Pine Manufacturers Association.

Export Grading Rules and Basic Schedule of Douglas Fir, Pacific (West Coast) Hemlock, Sitka Spruce, and Western Red Cedar Lumber—Pacific Lumber Inspection Bureau, Inc., 1929.

(See general list of Associations for addresses.)

Types and Sizes

(See Tables 6, 7, 8, 15, 16, 18.)

Unit Packages

Mill Products:

Siding
drop, rustic, bungalow or colonial bevel, etc.
car lining, etc.
stock is bundled (see Grading Rules for lengths and unit packages), sold on board feet content based upon actual size of stock prior to fabrication
frequently this stock in retail yards is sold on lineal foot basis

Flooring, decking, roofing, ceiling, partition, shiplap
stock is bundled (see Grading Rules for lengths and unit packages), sold on board feet content based upon actual size of stock prior to fabrication
frequently this stock in retail yards is sold on lineal foot basis

Finish lumber
stepping, casing and base stock, molding stock, corn-cribbing, silo stock
sold on board feet basis; generally not bundled
contents based on actual size prior to machining and fabrication

Molding
bundled separate lengths usually sold on lineal foot basis

Rough Lumber:

Common boards, common dimension, structural dimension, stringers, girders, beams ties
railroad and car stock (sills, plates, etc.)
sold on board feet content, based on rough size

Shipping Weights

TABLE 118

West Coast Lumbermen's Association—Standard Association Weights
Shipping Weights on Which Delivered Values are Based
Douglas Fir

Base	2500	Dimension, Rough	3300
Boards S1S, S1S1E or S2S	2600	2 x 4, 2 x 6 & 2 x 8 S1S1E or S4S	2600
Rough	3300	2 x 10 and 2 x 12	2700
Casing	2000	2 x 14 and 2 x 16	2800
Ceiling ⅝ x 4	1400	2 x 18 and wider	3000
Ceiling 1 x 4	2000	Flooring 1 x 3 to 1 x 6	2000
Corn Cribbing	2600	1¼ x 3 to 1¼ x 6	2200
Drop Siding & Rustic	2000		

TABLE 118—*Continued*

Finish—	
1 x 4 and wider S2S or S4S	2500
1 x 4 and wider S2S or S4S 13/16″	2700
Rough Dry 1″	3000
Rough Dry Thicker than 1″	3200
Rough Green	3500
1¼″, 1½″ and 2″ S2S or S4S	2700
Lath	500
Plank and small timbers S1S1E or S4S—	
3 x 3 and 3 x 4 and 3 x 6	2900
4 x 4 and 4 x 6	3000
3 x 8 and 4 x 8	3100
3 x 10 to 4 x 16	3100
6 x 6, 6 x 8 and 8 x 8	3000
Rough	3300
Stepping	2700
Shiplap	2600
Silo staves	2500
Turning squares rough—	
Green	3500
Rough dry	3200
S4S green	3000
S4S dry	2800
Tank stock S2S or S4S—	
Green	3200
Dry	3000
Rough green	3500
Rough dry	3200
Timbers, S1S1E or S4S	3000
Rough	3300
Well Curbing	2600
Windmill stock	3000

Ordering

Clearly specify whether Douglas fir or red fir is required

Definitely state if structural material is needed and structural grades required

State quantity (board feet, bundles, pieces, etc.)

State grade, thickness, and width (see Grading Rules for length of stock allowed per grade)

Specify moisture content (kiln-dried, air-dried, etc.)

Indicate approximate data of delivery

Caution

Shipments to the East are made by rail, boat (Panama Canal), or by boat and rail.

Clearly specify type of shipment preferred. Since rail rates are high, only kiln-dried uppers are usually handled in this manner. Green structural material may be shipped by boat.

Douglas fir is rather resistant to decay, but for use under extreme conditions favorable to decay, it should be treated *before shipment*, especially sapwood.

Yard grades of Douglas fir are based on the general utility of the piece. Structural grades are primarily based upon the strength of the piece. Factory grades are intended for recutting, and are based fundamentally upon cutting areas, and are not considered as yard lumber.

Read carefully under special provisions in the Grading Rules the interpretations for close grain, dense material, etc.; also, comparison of structural grades to yard grades.

In incoming shipments check up the following:

Whether stock conforms to grades and specifications of order

Moisture content

Damage in shipment

In fabricated or patterned stock see that it agrees with pattern specified

Check footage, bundles, pieces, etc.

(Properly store and handle incoming shipment, particularly kiln-dried stock.)

Special Service Requirements

Douglas fir is one of our leading structural woods. Numerous manufacturers have specialized in structural timbers. In ordering, indicate the exact use for which the material is intended; a recheck on your specifications is sometimes helpful and economical.

If yard lumber, yellow or red makes little difference in the strength in equivalent grades.

Special squares of large dimension and exceptionally long length are available from this species.

In creosoting work, facilities are often available at the mill or near-by vicinity which will effect considerable savings in handling costs, etc.

Specifications

The following publications may be consulted for information regarding specifications for Douglas fir:

Lumber—Simplified Practice Recommendation—Bureau of Standards.
Standards and Specifications in the Wood-Using Industries—Bureau of Standards.
National Directory of Commodity Specifications—Bureau of Standards.

(See general Bibliography for publishers' addresses.)

Engineering Data

(See Table 2.)

Attention is called to stress values for structural grades of Douglas fir, as indicated in Tables 155 to 160.

Improvements

Manufacturers of Douglas fir are directing special effort along the following lines to effect improvements in their products:

To cut lumber to conform to American Lumber Standards
To meet requirements of buyers desiring kiln-dried, partly dry, and dry lumber and commodity products
To distribute lumber which conforms to the grade specified
To adopt grade marking of various items
To specialize in structural stock that definitely meets the requirements of the consumer
In transcontinental shipments, or shipments by rail and boat, to effect all possible precautions to prevent damage or degrade, loss of time in delivery, etc.

Associations

The following associations will be glad to give information regarding lumber and other stock cut from Douglas fir:

West Coast Lumbermens Association.
Western Pine Manufacturers Association.
National Lumber Manufacturers Association.
Western Planing Mill and Wood Working Association.
California White and Sugar Pine Association.

(See general list of Associations for addresses.)

Publications

The following publications frequently carry trade items regarding Douglas fir, prices, etc.

American Builder
American Lumberman
American Woodworking Review
Building Material Merchant
California Lumber Merchant
Crow's Pacific Coast Lumber Digest
Four L Lumber News
Lumber Co-Operator
Lumber Trade Journal
Millwork
Mississippi Valley Lumberman
National Lumberman
National Retail Lumber Dealer
New York Lumber Trade Journal, The

Retail Lumberman
Retail Lumber Trade News
Timberman, The
Veneers
West Coast Lumberman
Western Retail Lumberman
Western Wood Worker and Furniture Manufacturer
Wood Workers Clearing House Journal
Wood Construction
Wood Preserving News
Wood-Worker, The
Wood Working Industries

(See general list of Periodicals for publishers' addresses.)

Bibliography

The following books and articles may prove helpful to readers desiring further information:

American Forest Trees—Henry H. Gibson.
Timber, Its Strength, Seasoning and Grading—H. S. Betts.
The Growth and Management of Douglas Fir in the Pacific Northwest—Thornton T. Munger.
Douglas Fir: A Study of the Pacific Coast and Rocky Mountain Forms—E. H. Frothingham.
Lumber and Its Uses—R. S. Kellogg.
Properties and Uses of Douglas Fir—McG. Cline and J. B. Knapp.
Canadian Douglas Fir, Its Mechanical and Physical Properties—R. W. Sterns.

(See general Bibliography for publishers' addresses.)

The following pamphlets have been published by the West Coast Lumbermen's Association and contain pertinent data on uses, properties, etc., of Douglas fir:

Douglas Fir Bridge Material.
Douglas Fir Cross Ties.
Douglas Fir—How to Compare it with Other Species.
Douglas Fir and Southern Pine—A Comparison of Physical and Mechanical Properties.
Douglas Fir—Working Stresses for Standard Grades.
Durable Douglas Fir—America's Permanent Lumber Supply.
Durable Douglas Fir—Sash and Frames.
Development of Structural Grades in American Lumber Standards, The.
Exploits of the Douglas Fir.
Forever West Coast Woods.
There is No Equivalent to All-Heartwood, Vertical Grain Douglas Fir Sash and Frames.
West Coast Car Material.
West Coast Offerings for the Signal Department.
West Coast Woods for Railroad Use.
Working Stresses for Structural Grades of American Lumber Standards.

(See general list of Associations for addresses.)

Abbreviations and Terminology

Doug. fir—Douglas fir
D. fir—Douglas fir
Fir—Douglas fir

(See general list of Abbreviations and Glossary.)

THE WHITE FIRS[1]

(Softwoods)

WESTERN SPECIES

ALPINE FIR
Abies lasiocarpa

GOLDEN FIR (CALIFORNIA RED FIR)
Abies magnifica

NOBLE FIR
Abies nobilis

SILVER FIR
Abies amabilis

WHITE FIR
Abies concolor

LOWLAND FIR
Abies grandis

EASTERN SPECIES

BALSAM FIR
Abies balsamea

SOUTHERN BALSAM FIR
Abies fraseri

ANNUAL PRODUCTION (1928) ..... 292,085,000 bd. ft.
AVERAGE VALUE OF LUMBER CUT AT MILL PER M.B.F. (1928) $20.00
TIMBER STAND (1920) ..... 91,349,000,000 bd. ft.

PRINCIPAL STATES PRODUCING CUT—IN ORDER OF IMPORTANCE (1928):

California—Nevada, Idaho, Washington, Oregon, New Mexico.

Range of Species

Western Species:

ALPINE FIR: Rocky Mountain region from northern Arizona (San Francisco Mountains), New Mexico (Sandia and Mogollon Mountains) to Montana and Idaho, and westward through the mountains of Oregon and Washington, and northward to Alaska (latitude 61°); high ranges of British Columbia and Alberta.

GOLDEN FIR (California Red Fir): California (Mount Shasta and throughout the western slopes of Sierra Nevada) and northward in the Cascade Mountains of southern Oregon.

NOBLE FIR: Washington (coast mountains in southwestern part of state; Olympic Mountains on Solduc River); and southward to northern California (Siskiyou Mountains); from Mount Baker southward (in the Cascade Mountains) to Oregon (Browder Ridge on headwaters of McKenzie River in Lane County).

SILVER FIR: From southeastern Alaska to Vancouver Island and British Columbia (Fraser River) and southward in the Cascade Mountains to northern Oregon; also in the coast mountains of Washington and Oregon.

WHITE FIR: Oregon (Siskiyou Mountains) to southern California (San Bernardino County); northern and southeastern Arizona (Santa Catalina, Rincon, Chiricahua,

[1] The species discussed under the "white" firs belong to the *true* fir group and are not to be confused with Douglas fir, which belongs to an entirely different genus and species.
Note also those species above which belong to the *true* fir group.

and Huachuca Mountains), and New Mexico to Colorado and Utah (Wasatch Mountains); Nevada; western Wyoming (plateau west of Maxon, Sweetwater County; west slope of Salt River Range, Uinta County); northern Mexico and Lower California. LOWLAND WHITE FIR: Coast region from Vancouver Island to California (Sonoma County), and from Washington and Oregon to northern Idaho and Montana.

Eastern Species:

BALSAM FIR: From Newfoundland and Labrador to Hudson Bay and northwestward to Great Slave Lake and Mackenzie River; thence to the headwaters of the Yukon River, northeastern British Columbia and northwestern Alberta; southward to Pennsylvania (and along high mountains to southwestern Virginia), Michigan (Saginaw Bay), northern Minnesota, and northeastern Iowa. Southern Balsam Fir: High mountains of the Virginias, North Carolina, and Tennessee.

There is now being produced on the West Coast lumber which is sold under the trade name "white fir" or "Commercial white fir." This lumber is cut from several species of the so-called white fir group.

It will be noted that in this group two species are found in the northeast and east and certain regions of the Appalachian mountains, known as balsam fir and southern balsam fir. Production figures are not available for these species but it is safe to say that a very small per cent of the total cut of "white fir" is obtained from the eastern species. The bulk of the balsam fir lumber and other products is usually consumed locally in the regions where it ranges. Most of the commercial production is obtained from the western species.

The term "white" fir has been created by lumbermen and applies to the color of the wood or branches, bark, etc. Strictly speaking, the wood in all species is not white but ranges from nearly white to a reddish-brown. For years the "white firs" have been looked upon with disfavor and for this reason the lumber has been sold under a multitude of trade and regional names.

The "white firs," strictly speaking, are considered as secondary softwood species in comparison with the other more important and valuable species.

Usual Name

"White fir" or "commercial white fir"

Also Called

Western Species:

ALPINE FIR

Alpine fir (Colo., trade)
Sub-alpine fir (Utah)
Balsam (Colo., Utah, Idaho, Oreg.)
White fir (Idaho, Mont.)
White balsam (Colo., Utah)
Oregon balsam-tree
Pumpkin-tree
Mountain Balsam (Utah, Idaho)
Down-cone fir (lit.)
Downy-cone sub-alpine fir (Calif., lit.)
Black balsam (Colo.)
Balsam fir (Wyo.)

GOLDEN FIR (California Red Fir)

Red fir (Calif.)
California red-bark fir (Calif.)
Magnificent fir (Calif. lit.)
California red fir (Calif., lit. and trade)
Golden fir (Calif. lit.)

NOBLE FIR

Red fir (Ore.)
"Larch" (Ore. lumbermen)
Noble fir (Ore.)
Bigtree
Feather-cone red fir (Calif. lit.)
Noble or bracted red fir (Calif. lit.)
Tuck Tuck (Pacific Indians)

SILVER FIR

Red fir
Red silver fir (western mountains)
Fir (Calif.)
Lovely red fir (Calif. lit.)
Lovely fir (Calif. lit.)
Amabilis or lovely fir (Calif. lit.)
"Larch" (Ore. lumbermen)
White fir (lit. and trade)
Lovely silver fir (lit.)
Silver fir (trade)
Cascade fir (lit.)

WHITE FIR

White fir (Calif., Ore., Idaho, Utah, Colo., and trade)
Balsam fir (Calif., Ore., Idaho, Colo., and trade)
Silver fir (Calif., Colo.)
Balsam (Calif., Colo., Utah)
White balsam (Utah)
Bastard pine (Utah)
Balsam-tree (Idaho)
Black gum (Utah)
California white fir (Calif.)
Colorado white fir (Colo., Calif. lit.)
Concolor silver fir (Eng. lit.)
Colorado silver fir (lit.)
Blue fir (Colo.)

LOWLAND WHITE FIR

White fir (Calif., Ore., Wash., Idaho, Mont., and trade)
Silver fir (Wash., Mont., Idaho)
Yellow fir (Mont., Idaho)
Oregon white fir (Calif.)
Western white fir
Grand or Oregon white fir (Calif. lit.)
Great California fir (lit.)
Puget Sound fir (Eng. lit.)
Lowland fir (lit.)
Rough-barked fir (Wash.)
Great silver fir (Idaho, Mont.)
Balsam fir (Ore. and trade)
Lowland white fir (trade)
Grand fir (lit.)
Giant fir (Eu. lit.)

Eastern Species

BALSAM FIR

Balsam fir (N. H., Vt., Mass., N. Y., Pa., W. Va., Wis., Mich., Minn., Nebr., Ohio, Ontario, Eng., and trade)
Balsam (Vt., N. H., N. Y., and trade)
Canada balsam (N. C.)
Balm-of-Gilead
Balm-of-Gilead fir (N. Y., Pa., W. Va.)
Blister pine (W. Va.)
Fir pine (W. Va.)
Firtree (Vt.)
Single spruce (N. Bruns. to Hudson Bay)
Silver pine (Hudson Bay)
Sapin (Quebec)
Cho-koh-tung = "Blisters" (N. Y. Indians)
Eastern fir (trade)

SOUTHERN BALSAM FIR

Balsam (N. C., Tenn.)
Balsam fir (N. C.)
Double fir balsam (Tenn.)
Double spruce (N. C.)
She balsam (N. C., Tenn.)
She balsam fir (N. C.)
Mountain balsam (N. C.)
Healing balsam
Lashorn balsam spruce (N. C.)
Fraser fir (lit.)
Eastern fir (trade)
Southern balsam fir

Description

The wood of the white firs has common characteristics and properties, in that it is light in weight, soft, easily worked with often a tendency towards brashness and occasional splintering.

In the West there is a tendency among lumbermen to class the true firs as either red or white according to the color of the heartwood.

None of the firs are considered as highly durable woods. They lack objectionable odor.

Alpine fir:

Wood is narrow grained, soft, light and weak, often splintering. The wood varies from pale straw to light yellowish-brown.

Golden fir (California red fir):

The golden or California fir is perhaps the largest and best representative of the white firs. It takes its name from the reddish tinge of the heartwood. The wood, by some, is said to surpass the other firs in properties. The heartwood is distinguishable from the sapwood in that it is much darker in color than the light pink sapwood. The wood is usually close-grained and straight, but soft, light in weight, and easily fabricated. It is easily dried but care must be given to prevent warping, twisting, and splintering.

Noble fir:

The wood of noble fir is comparatively close-grained, slightly lighter than Douglas fir, soft, easily worked but very weak. It shows no figure. The heartwood is pale brown with a reddish tinge sometimes streaked with red, while the sapwood is darker. It finishes smoothly.

Silver fir:

The wood of silver fir is close-grained and weak. It is subject to splitting and finishes rather poorly. It is somewhat harder and stiffer than the other true firs. The heartwood is pale brown and sapwood white with brownish tinge. It closely resembles spruce in appearance.

White fir:

This fir received its name from the whiteness of the wood and branches. Frequently the wood is coarse-grained and splintery. The wood is soft and weak, often brash. Heartwood and sapwood are practically white in color.

Lowland white fir:

The wood is usually of fast growth resulting in wide heart rings. The heartwood is nearly white to pale brown with little striking color variation to its sapwood. The wood is light in weight, soft, weak, but fabricates easily. Because of its large size it affords considerable quantities of clear, wide stock.

Balsam fir:

Balsam fir seldom attains large size. The heartwood is pale brown with a yellow cast while the thick sapwood is much lighter in color. It is about equal to white pine in weight but is weak, brash, and soft, and shows no figure.

Southern balsam fir:

The wood of the southern balsam fir closely resembles the true or northern balsam fir in general appearance. It is, however, the lightest of the true white firs but is stronger than the true balsam fir.

Uses

Alpine fir does not figure extensively in the output of the western white firs.

The white firs as they occur in the forest seldom are in solid stands and are cut as they are found in growth with other species. The white fir lumber has been mixed with other species in the past and no attempt is made to segregate them according to species. For this reason it is difficult to ascertain the yearly cut of the various species.

The western white firs are used principally for boxes and crates, shipping containers, rough lumber purposes, and of late for dimension, flooring, and interior trim. Some quantity is being used for core stock.

Balsam fir in the regions of its growth is used locally for various purposes. Its most extensive use is for pulpwood, containers, veneer boxes, boxes, and crates. It is also used for the manufacture of excelsior and slack cooperage. Of late balsam fir is being used for rough dimension, novelty products, and interior trim.

It also supplies the Canada balsam, a widely known medicinal product.

Southern balsam fir, because of its limited range, is not in any sense an important commercial species. Its most important use is for pulpwood.

Classifications

The western white firs are graded in accordance to the following grading rules:

Standard Grading Rules for Pondosa Pine, California White Pine, Sugar Pine, Idaho White Pine, Larch, Douglas Fir, White Fir, Spruce and Cedar Lumber. Published jointly by Western Pine Manufacturers Association and California White and Sugar Pine Manufacturers Association.

Balsam fir grading rules are covered by individual rules established by the various producing mills.

(See general list of Associations for addresses.)

Types and Sizes

Special attention is called to discussion given in grading rules for "white" fir to various sizes, types, and grades, as designated and extract given below taken from grading rules.

Paragraph No. 233,

"*White Fir*, Douglas Fir, Spruce and Cedar two inches and less in thickness, except Dimension are under rules that are used for the inspection of Pine Lumber."

White firs are manufactured according to American Lumber Standards both as to sizes and grades. (See tables 6, 7, 8, 15, 16, 18.)

Unit Packages

The western white firs are sold on standard grade basis and measured on a board feet content basis. Balsam fir, when cut in form of lumber and dimension, frequently is sold on mill run and log run basis.

Shipping Weights

Shipping weights for the western "white" firs are estimated by the Western Pine Manufacturers Association to be the same as for Idaho white pine. (See Table 123.)

Balsam fir would carry approximately the same weights as northern white pine. (See Table 124.)

Ordering

In ordering it is well to specify "commercial white fir" or "white fir" for those western species which are being cut for this type of stock.

Under specific conditions where the balsam fir is required it should be so written and stated in the order.

(For other points refer to discussion on Ordering.)

Caution

The "white" firs are frequently cut and sold for other species of softwoods. This was due to the lack of definite uses for the wood and was unknown to many consumers.

"White" fir has for its most serious faults the weakness and softness of the wood which should be considered in considering the adaptability of these species for uses where strength is preëminently required.

They are not durable in contact with the ground but are susceptible to preservative treatment.

Special Service Requirements

"White" fir, because of its special properties and characteristics, offers special service for box and crate construction and specialty products. The wood is soft, easily worked, and nails well. It is reasonably economical and in the future will increase in importance.

Specifications

The following publications may be consulted for information regarding specifications for "white" fir:

Standards and Specifications in the Wood-Using Industries—Bureau of Standards.
Lumber—Simplified Practice Recommendation—Bureau of Standards.

(See general Bibliography for publishers' addresses.)

Engineering Data

Mechanical properties, including shrinkage, weights per cu. ft., etc., for the western "white" firs and balsam fir are shown in Table 2.

Improvements

Mills producing "white" fir, particularly in the West, have improved methods for the drying of fir lumber and millwork. More care is being shown in the grading and selection of lumber which insures a more uniform run of stock.

Mechanical tests have developed information regarding the properties of the species, thus clearing up many points.

Fabricating methods in machining and working stock are constantly being improved.

Associations

The following Associations will be glad to give information regarding lumber and other stock cut from "white" fir:

Western Pine Manufacturers Association.
California White and Sugar Pine Manufacturers Association.
National Lumber Manufacturers Association.

(See general list of Associations for addresses.)

Publications

The following publcations frequently carry trade items regarding "white" fir:

American Builder
American Lumberman
American Woodworking Review
Building Material Merchant
California Lumber Merchant
Crow's Pacific Coast Lumber Digest
Four L Lumber News
Lumber Co-Operator
Lumber Trade Journal
Millwork
Mississippi Valley Lumberman
National Lumberman
National Retail Lumber Dealer
New York Lumber Trade Journal, The
Retail Lumber Trade News
Retail Lumberman
Timberman, The
Veneers
West Coast Lumberman
Western Retail Lumberman
Western Wood Worker and Furniture Manufacturer
Wood Construction
Wood Preserving News
Wood-Worker, The
Wood Workers Clearing House Journal
Wood Working Industries

(See general list of Periodicals for publishers' addresses.)

Bibliography

The following books may prove helpful to readers desiring further information:

American Forest Trees—Henry H. Gibson.

Lumber and Its Uses—R. S. Kellogg.

(See general Bibliography for publishers' addresses.)

Abbreviations and Terminology

W. F.—white fir
W. Fir—white fir

(See general list of Abbreviations and Glossary.)

EASTERN HEMLOCK[1]

(A Softwood)

Tsuga canadensis

ANNUAL PRODUCTION (1928) ..... 674,943,000 bd. ft.
AVERAGE VALUE OF LUMBER CUT AT MILL PER M.B.F. (1928) $22.59
TIMBER STAND (1920) ..... 30,896,000,000 bd. ft.

PRINCIPAL STATES PRODUCING CUT—IN ORDER OF IMPORTANCE (1928):

Michigan, Pennsylvania, West Virginia, Maine, New Hampshire, Tennessee, New York, North Carolina, Massachusetts.

Range of Species

Nova Scotia to Minnesota, to southwestern Wisconsin, southern Michigan, and Indiana; southward in the Atlantic region to Delaware and Maryland and southward along the mountains to northern Alabama and Georgia.

Usual Name

Eastern hemlock

Also Called

Hemlock (Me., N. H., Vt., Mass., R. I., Conn., N. Y., N. J., Pa., Del., W. Va., Va., N. C., S. C., Ky., Wis., Mich., Minn., Ohio, Ontario and trade)
Hemlock spruce (Vt., R. I., N. Y., Pa., N. J., W. Va., N. C., S. C., England)
Spruce (Pa., W. Va., N. C.)
Wisconsin white hemlock (trade)
Spruce pine (Pa., Del., Va., N. C., Ga.)
Oh-neh-tah—"Greens-on-the-stick" (N. Y. Indians)
Canadian hemlock (lit.)
New England hemlock (lit.)
Pine (Pa.)
Red hemlock (W. Va.)
White hemlock (W. Va.)
White spruce (Ky.)
West Virginia hemlock (trade)
Pennsylvania hemlock (trade)
Pennsylvania white hemlock (trade)
Huron pine (Mich., trade)
Canada hemlock (lit., hort.)

[1] There are two principal species of hemlock which afford the commercial supply of hemlock lumber. They are the eastern hemlock, which is confined mostly to the eastern part of the United States, and the western hemlock, a typical West Coast species. The term "western hemlock" is used by the Forest Service.

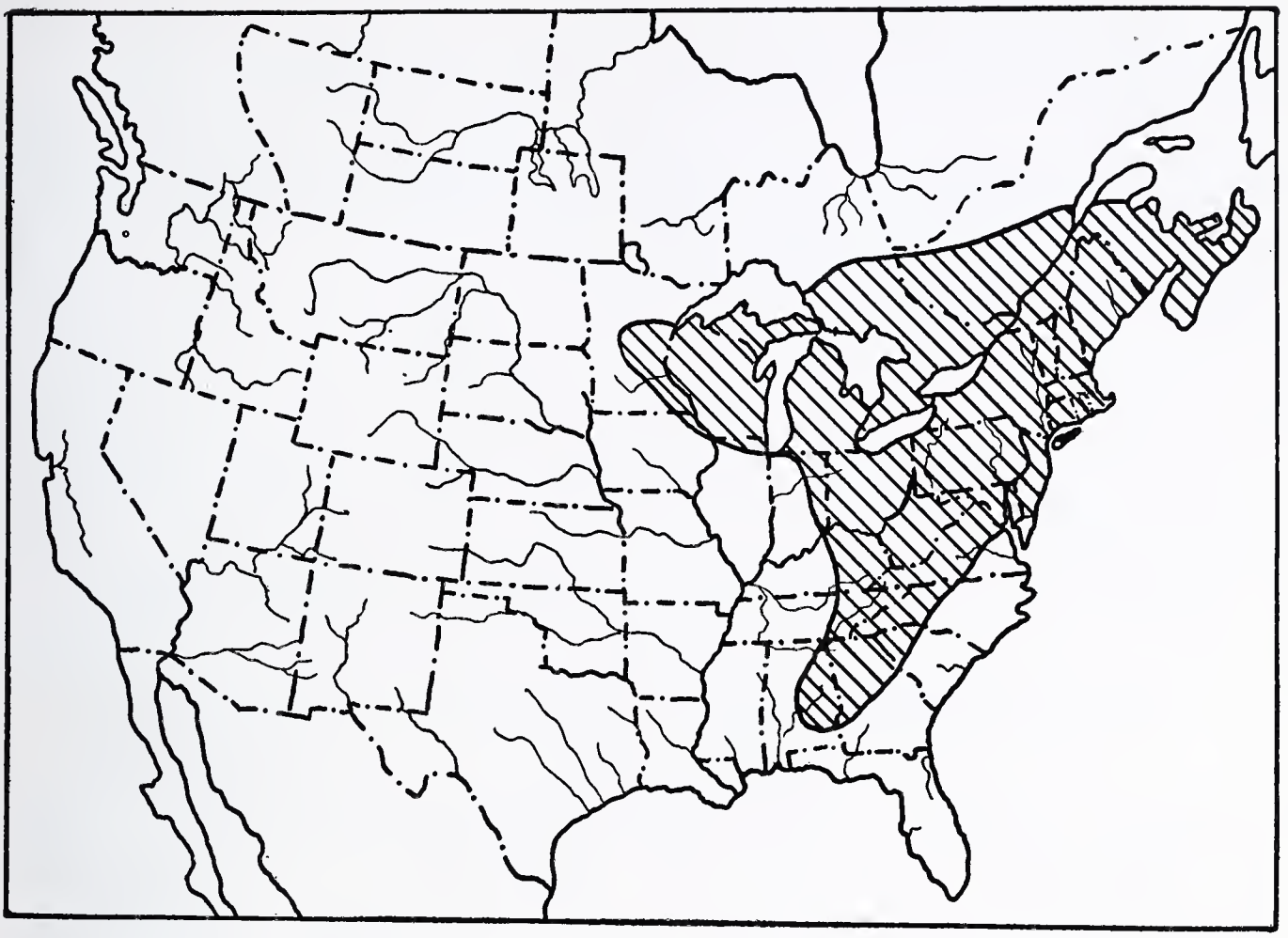


Illustration 49—General range of eastern hemlock.

Description

Eastern hemlock is light, straight, fine-textured, and at times somewhat splintery in the rough or when it has not been milled properly. In contact with the soil it is not classified with the durable woods, but it is very seldom that it is subject to dry rot in buildings. In Wisconsin and Michigan such reports are unknown. The heartwood is light brown, while the sapwood is still lighter in color.

TABLE 119

Eastern Hemlock	West Coast Hemlock
Wood is light, rather soft, and has a tendency to be brittle.	Is stronger and stiffer
Often accompanied by shake.	Is not pitchy.
Contains no pitch.	Wood works well.
Tendency towards splintering and is difficult to work.	Grain is coarse, but less so than eastern hemlock.
Grain is coarse and often crooked.	Heartwood pale brown tinged with yellow; sapwood thin; white in color.
Heartwood is light brown, tinged red, often white.	Fairly durable in contact with the soil.
Sapwood is darker.	
Not considered durable.	
Wood is moderately light, but slightly heavier than ~~eastern~~ Western hemlock.	
Both species possess remarkable nail holding qualities and resist splitting.	

Uses

Eastern hemlock has been considered an important commercial species for many years, particularly because of the increasing scarcity of northern white pine and Norway pine.

It has been used extensively for framing, sheathing, rough construction, ties, boxes, and crates. At present large amounts are used for flooring and construction.

Classifications

For detailed information regarding grading rules, specifications, etc., consult *Official Grading Rules for Hemlock and Tamarack Lumber*, published by Northern Hemlock and Hardwood Manufacturers Association.

(See general list of Associations for addresses.)

Types and Sizes

(See Tables 6, 7, 8, 15, 16, 18.)

Unit Packages

Eastern hemlock rough lumber is sold on board feet basis and manufactured in accord with American Lumber Standards.

Shipping Weights

Estimated weights for eastern hemlock are as follows:

TABLE 120

NORTHERN HEMLOCK AND HARDWOOD MANUFACTURERS ASSOCIATION

ESTIMATED WEIGHTS OF HEMLOCK LUMBER

Per M Feet—Shipping Dry

3″ plank, rough	3000	2″ piece stuff, rough or S1E	2500
3″ plank, 4 x 4 to 8 x 8, S1S1E	2700	2″ piece stuff, S4S or D&M	2000
3″ plank, S4S or D&M	2500	1″ boards, rough	2500
4 x 10 to 12 x 12, rough	3500	1″ boards, S1S or S2S	2000
4 x 10 to 12 x 12, S1S1E	3200	1″ clear and select, S1S	2000
4 x 10 to 12 x 12, S4S	3000	Shiplap, D&M or drop siding	1800
4 x 4 to 8 x 8, rough	3000	1 x 6 well tubing, beveled edges	1800
Thick D and better, S1S	2500	Sheathing lath	1500
Thick D and better, S1S1E	2200	Lath	500
2″ piece stuff, S1S1E	2200	32″ lath	300
2″ piece stuff, S1S or S2S	2200		

Ordering

(See general instructions about ordering.)

Caution

(See general instructions under this heading.)

Special Service Requirements

Eastern hemlock is an important species for building and construction use. Its abundance and general availability should be considered in sections where other softwood species cannot compete or be used economically.

Specifications

Lumber—Simplified Practice Recommendation—Bureau of Standards.
Standards and Specifications in the Wood-Using Industries—Bureau of Standards.
National Directory of Commodity Specifications—Bureau of Standards.

(See general Bibliography for publishers' addresses.)

Engineering Data

(See Table 2.)

Improvements

Prejudice against hemlock, due to lack of knowledge of its properties, wood structure, etc., formerly resulted in a feeling that this wood was of little or no value. This prejudice to a great extent was due to improper manufacture and marketing.

In the East it was cut and sold on a log run basis, and little attempt was made to grade or cut to standard sizes. Today definite grades and standards have been developed which have resulted in a superior product. The 2-inch stock is cut extra thick (industrial standard or extra standard), thus counterbalancing in extra material the slightly greater strength of some other structural woods.

Grade marking assures a guarantee of grades which conform to accepted standards and sizes especially adapted for general building and construction work.

Associations

The following association will be glad to give information regarding lumber and other stock cut from eastern hemlock:

Northern Hemlock and Hardwood Manufacturers Association

(See general list of Associations for address.)

Publications

The following publications frequently carry trade items concerning eastern hemlock:

American Builder
American Lumberman
American Woodworking Review
Gulf Coast Lumberman
Lumber Co-Operator
Lumber Trade Journal
Millwork
Mississippi Valley Lumberman
National Lumberman
National Retail Lumber Dealer
New York Lumber Trade Journal, The
Retail Lumberman
Retail Lumber Trade News
Southern Lumberman
Veneers
Wood Workers Clearing House Journal
Wood Construction
Wood Preserving News
Wood-Worker, The
Wood Working Industries

(See general list of Periodicals for publishers' addresses.)

Bibliography

The following books and articles may prove helpful to readers desiring further information:

Eastern Hemlock—Forest Service Bulletin No. 152.
"Commercial Importance of Hemlock"—A. H. D. Ross, *Canadian Lumberman and Woodworker*—Toronto, Canada, 1915.
American Forest Trees—Henry H. Gibson.
Handbook of Trees in the Northern States and Canada—R. B. Hough.
Lumber and Its Uses—R. S. Kellogg.

(See general Bibliography for publishers' addresses.)

Abbreviations and Terminology

(See general list of Abbreviations and Glossary.)

WEST COAST HEMLOCK[1]

(A Softwood)

Tsuga heterophylla

ANNUAL PRODUCTION.....1,546,813,000 bd. ft.
AVERAGE VALUE OF LUMBER CUT AT MILL PER M.B.F. (1928).....$21.00
TIMBER STAND.....950,920,000,000 bd. ft.

PRINCIPAL STATES PRODUCING CUT—IN ORDER OF IMPORTANCE:

Washington, Oregon, California.

Range of Species

From southeastern Alaska to northern Idaho and northwestern Montana, and southward in Washington and Oregon.

Usual Name

West Coast hemlock

Also Called

Hemlock spruce (Calif.)
Western hemlock (Calif.)
Hemlock (Alaska, Ore., Idaho, Wash., Mont., trade)
Western hemlock spruce (lit.)
California hemlock spruce
Western hemlock fir (Eng.)
Prince Albert's fir (Eng.)
Alaska pine (northwestern lumbermen)
Pacific hemlock (trade)
Pacific Coast hemlock (trade)
Pacific western hemlock (trade)
Pacific (western) hemlock (trade)

Description

The wood of eastern and West Coast hemlock differs somewhat, although used for practically the same purposes in the trade. Table 119 will be of some assistance in pointing out such differences.

Uses

Both eastern and West Coast hemlock are used extensively for building and construction purposes.

West Coast hemlock is remarkable for its extensive growth and is one of the most

[1] American Lumber Standards have designated the trade name "West Coast Hemlock" for this species.

Illustration 50—General range of West Coast hemlock.

important woods in America. Today it has become a leading competitor with most other softwoods. Its principal use is for construction purposes and it is used for flooring, sheathing, siding, dimension, and timbers. Large amounts are consumed in the manufacture of boxes and crates, veneers for berry boxes, and vegetable crates. It also finds an important use for burial boxes, sash, door, frame, and millwork products.

Classifications

For detailed information regarding grading rules, specifications, etc., consult:

Standard Grading and Dressing Rules for Douglas Fir, Sitka Spruce, West Coast Hemlock, and Western Red Cedar Lumber—West Coast Lumbermen's Association

(See general list of Associations for addresses.)

Types and Sizes

See Tables 6, 7, 8, 15, 16, 18.)

Unit Packages

West Coast hemlock is sold and manufactured in accordance with American Lumber Standards. Rough lumber is sold on board feet basis.

West Coast hemlock products (except bungalow siding, bevel siding, and box lumber) are graded by the same rules as Douglas fir. See Grading Rules for exceptions, definitions of defects, lengths, bundles, etc.

Shipping Weights

The West Coast Lumbermen's Association designates shipping weights for West Coast hemlock as being the same as those for Douglas fir items, except that bevel siding weighs 900 lbs. per 1,000 bd. ft.

Ordering

(See general instructions on this subject.)

Caution

(See general instructions on this subject.)

Special Service Requirements

West Coast hemlock is available in wide stock and extra long lengths, particularly for dimension. Both the eastern and the western hemlocks are used extensively for flooring.

Specifications

Lumber—Simplified Practice Recommendation—Bureau of Standards.
Standards and Specifications in the Wood-Using Industries—Bureau of Standards.
National Directory of Commodity Specifications—Bureau of Standards.

(See general Bibliography for publishers' addresses.)

Engineering Data

(See Table 2.)

Improvements

Prejudice against hemlock, due to lack of knowledge of its properties, wood structure, etc., formerly resulted in a feeling that this wood was of little or no value. This prejudice, to a great extent, was due to improper manufacture and marketing.

Associations

The following association will be glad to give information regarding lumber and other stock cut from West Coast hemlock:

West Coast Lumbermen's Association.

(See general list of Associations for address.)

Publications

The following publications frequently carry trade items regarding West Coast hemlock:

American Builder
American Lumberman
American Woodworking Review
Building Material Merchant
California Lumber Merchant
Crow's Pacific Coast Lumber Digest
Four L Lumber News
Lumber Co-Operator
Lumber Trade Journal
Millwork
Mississippi Valley Lumberman
National Lumberman
National Retail Lumber Dealer
New York Lumber Trade Journal, The
Retail Lumberman
Retail Lumber Trade News
Timberman, The
Veneers
West Coast Lumberman
Western Retail Lumberman
Western Wood Worker and Furniture Manufacturer
Wood Workers Clearing House Journal
Wood Construction
Wood Preserving News
Wood-Worker, The
Wood Working Industries

(See general list of Periodicals for publishers' addresses.)

Bibliography

The following books and articles may prove helpful to readers desiring further information:

Properties of Western Hemlock and Their Relation to Uses of the Wood—JOHNSON and GIBBONS—Technical Bulletin No. 139, U. S. Dept. of Agriculture.

The Western Hemlock—E. T. ALLEN—Forest Service Bulletin No. 33.

"Western Hemlock, Its Forest Characterization, Properties and Uses"—E. J. HANZLICK and H. B. OAKLEAF—*The Timberman*, Portland, Oregon, Oct., 1914.

American Forest Trees—HENRY H. GIBSON.

Lumber and Its Uses—R. S. KELLOGG.

(See general Bibliography and general list of Periodicals for publishers' addresses.)

Abbreviations and Terminology

(See general list of Abbreviations and Glossary.)

LARCH

(A Softwood)

Larix occidentalis

Annual Production ..... 239,691,000 bd. ft.
Average Value of Lumber Cut at Mill per M.B.F. (1929)
(Exclusive of Ties and Mining Timbers) $17.58
Timber Stand ..... 25,000,000,000 bd. ft.

Principal States Producing Cut—in Order of Importance (1928):

Montana, Idaho, Washington, Oregon.

Range of Species

Grows chiefly in the drainage of the upper Columbia River. Its natural range extends from southern British Columbia to western slopes of the Continental Divide of northern Montana and eastern slopes of Cascade Mountains of Oregon. Reaches its best development in northeastern Washington, northern Idaho and western Montana. Ideal sites for larch are lower north and east slopes and sandy beaches.

Usual Names

Although the term "western larch" is applied to this species in some forestry and botanical publications, larch is the generally accepted name for the lumber produced from the species larix occidentalis.

The terms "larch" and "tamarack" have in the past been confused in the trade and have resulted in considerable unjustified prejudice against the former. Larch is much more important commercially. The production of tamarack is less than five per cent of that for larch and the latter is a finer growth wood, more easily worked, and possessing superior qualities.

Also Called

Tamarack (Ore.)
Hacakamtack
Larch (Idaho, Wash., trade, etc.)
Red American larch
Western tamarack
Great western larch (Calif., lit.)
Western larch (English and American trade; Mont.)
Montana larch (trade)
Mountain larch (trade)
British Columbia tamarack (Brit. Col. trade)
Oregon larch (Pacific Coast trade)

Description

The heartwood is a dark russet or bright reddish brown. The sapwood is straw colored, or light brown, and generally not more than ½ to ¼ of an inch thick.

The wood is close-textured, straight-grained, firm, moderately hard, durable, and heavy. In many properties and in general appearance it closely resembles cypress. It does

Illustration 51—General range of western larch.

not mar or dent easily and readily takes and holds stains, varnishes, oil finishes, and paints. It is a dense, strong wood of the small-knotted type and has many excellent qualities. When cut with the grain vertically, and properly seasoned, it is probably the best softwood available for flooring, for it wears evenly and keeps a smooth surface. It yields a beautifully

figured flat grain face; machines well, giving a smooth satiny surface; and takes any finish in an excellent manner. The nail holding power is very high, which permits the use of a smaller nail than usually is required.

Larch can be seasoned successfully and with suitable moisture content stays in place. Like all of the strong, high density woods, larch splits more easily than the soft pines, but this tendency is no greater than in competitive species.

Uses

The uses of larch are many and varied. Throughout its commercial range it is commonly mixed, particularly in the common grades, with Douglas fir and sold under the trade name "larch-fir."

Larch produces a relatively high percentage of selects, a substantial amount of the upper common grades, and dimension and small timbers in large volume. At the sawmill 50 to 60 per cent of the No. 3 common and better is made into such products as flooring, ceiling, partition, drop siding, car siding, shiplap, car lining, rustic, bevel siding, and molding. A list of uses follows:

Planing mill products
- Casings—window and door
- Ceiling and partition
- Doors—common and garage
- Flooring
- Frames—window and door
- Moldings
- Finish
- Siding
- Wainscoting

General building construction
- Posts
- Girders
- Stringers
- Planking
- Joists
- Studding
- Sheathing
- Sub-flooring
- Roofing
- Concrete forms
- Scaffolding
- Lath

Miscellaneous construction
- Corn-cribbing
- Cross arms
- Culverts
- Mine timbers
- Shelving
- Snow fencing
- Ties
- Well curbing
- Fence lath

Industrial or factory
- Boxing and crating
- Car construction
- Caskets and coffin boxes
- Cooperage
- Farm implements
- Furniture and fixtures
- Refrigerators
- Screens
- Signs
- Tanks and troughs
- Woodenware

Classifications

Detailed information regarding the grades, sizes, shipping, and inspection provisions for larch are found in the Standard Grading Rules of the Western Pine Manufacturers Association and of the California White and Sugar Pine Manufacturers Association.

(See general list of Associations for addresses.)

Types and Sizes

The following grades are available:

C & Btr. Select
D Select
No. 1 and 2 Common
No. 3 Common
No. 4 Common
No. 5 Common
No. 1 Dimension and Timbers
No. 2 Dimension and Timbers
No. 3 Dimension and Timbers

Larch is manufactured according to American Lumber Standards both as to sizes and grades. (See tables 6, 7, 8, 15, 16, 18.)

Unit Packages

Lumber is sold on board feet basis.

Stock that is bundled is tied separately, according to length. Finished stock, stock cut to pattern, or surfaced lumber is sold on board feet measure. Retail yards frequently sell on lineal feet basis. Board measure is based upon stock necessarily used in its manufacture.

Shipping Weights

TABLE 121

Estimated Shipping Weights for Larch—Western Pine Manufacturers Association

Kind of Stock	*Weight per M.B.F.*
2″ Dimension AW S1S1E	2,400 lbs.
4/4 to 8/4 rough	2,700 lbs.
Timbers and plank S4S	2,800 lbs.
Timbers, plank and ties, rough	3,300 lbs.
4/4 select and common S2S	2,200 lbs.
4/4 select and pattern	2,000 lbs.
5/8″ pattern	1,400 lbs.
3/8″ pattern	900 lbs.
Bevel siding	800 lbs.
4′ lath, larch and fir	600 lbs. per M pieces

Ordering

(Follow general ordering instructions. Also see instructions for ordering tamarack.)

Caution

Nominal 3″ larch dimension customarily is surfaced to 2½″ thickness.

Grading rules for larch apply to all widths and thicknesses, whether rough, S2S, S4S, or worked to pattern.

Douglas fir produced in the Inland Empire is of similar character and quality and is permitted in all grades of larch under the rules of the Western Pine Manufacturers Association.

Special Service Requirements

It is well to keep in mind that larch can be substituted in many cases for woods similar in character. It is admirable for rough construction purposes. Likewise it has an important use in the box and crate industry.

Specifications

The following publications may be consulted for information regarding specifications for larch:

Lumber—Simplified Practice Recommendation—Bureau of Standards.
Standards and Specifications in the Wood-Using Industries—Bureau of Standards.
National Directory of Commodity Specifications—Bureau of Standards.

(See general Bibliography for publishers' addresses.)

Engineering Data

(See Table 2.)

Improvements

(See general discussion on improvements.)

Associations

The following associations will be glad to give information regarding lumber and other stock cut from larch:

Western Pine Manufacturers Association.
California White and Sugar Pine Manufacturers Association.

(See general list of Associations for addresses.)

Publications

The following publications frequently carry items on larch:

American Builder
American Lumberman
American Woodworking Review
Building Material Merchant
California Lumber Merchant
Crow's Pacific Coast Lumber Digest
Four L Lumber News
Lumber Co-Operator
Lumber Trade Journal
Millwork
Mississippi Valley Lumberman
National Lumberman
National Retail Lumber Dealer
New York Lumber Trade Journal, The
Retail Lumber Trade News
Retail Lumberman
Timberman, The
Veneers
West Coast Lumberman
Western Retail Lumberman
Western Wood Worker and Furniture Manufacturer
Wood Workers Clearing House Journal
Wood Construction
Wood Preserving News
Wood-Worker, The
Wood Working Industries

(See general list of Periodicals for publishers' addresses.)

Bibliography

The following books and articles may prove helpful to readers desiring further information:

Mechanical Properties of Western Larch—Forest Service Bulletin No. 122.
American Forest Trees—Henry H. Gibson.
Lumber and Its Uses—R. S. Kellogg.
Montana Forest and Timber Handbook—State University of Montana

(See general Bibliography for publishers' addresses.)

Abbreviations and Terminology

Larch rarely is abbreviated.

(See general list of Abbreviations and Glossary.)

IDAHO WHITE PINE[1]

(A Softwood)

Pinus monticola

ANNUAL PRODUCTION.....529,026,000 bd. ft.
AVERAGE VALUE OF LUMBER CUT AT MILL PER M. B. F. (1929).....$28.26
TIMBER STAND.....25,000,000,000 bd. ft.

PRINCIPAL STATES PRODUCING CUT—IN ORDER OF IMPORTANCE (1928):

Idaho, Washington, Montana, Oregon.

Range of Species

Found most abundantly in the northern part of Idaho between the Canadian line and the Salmon River. It also grows in commercial quantities in eastern Washington, southern British Columbia, and western Montana adjacent to the Idaho state boundary. Its botanical range extends through the Olympic Mountains and Cascade Mountains at high elevations in Washington and Oregon and southward into California. In these latter locations, however, it is seldom found in sufficient volume for the lumber to be marketed as a distinct species, and the little that is cut outside of its commercial tree zone is more often mixed with other kinds of lumber.

Usual Names

Practically all of the lumber of this species that is offered in American markets is sold under one of the following names:

Idaho white pine
Genuine white pine
White pine
Idaho pine (limited use)
British Columbia white pine

Idaho white pine is the term designated in American Lumber Standards as the common name for the species Pinus monticola, and is the one most often used in the trade.

A number of strictly local names are applied to this tree in certain districts where it grows, but they are of no value from a commercial lumber viewpoint. *Forestry*, and other similar publications on trees, sometimes refer to this species by the name western white pine, but the lumber is not sold by that name. In fact the term western white pine was for a number of years the name applied to another species of western lumber. If the buyer will follow the American Standard designation—Idaho white pine—there will be no confusion over the name.

Also Called

White pine (Calif., Nev., Ore.)
Mountain pine (Calif.)
Fingercone pine (Calif.)
Soft pine (Calif.)

[1] In the Forest Service Idaho white pine is termed western white pine.

Little sugar pine (Calif.)
Mountain Weymouth pine
Western white pine
Norway western white pine (trade)
Soft Idaho white pine (trade)

Illustration 52—General range of Idaho white pine.

Description

There are only three species of genuine white pine of commercial importance in the United States. Idaho white pine is one; northern white pine and sugar pine are the other two.

The difference between the lumber of each species is so slight ordinarily that it is difficult for even the expert wood technologist to tell them apart. Their similarity is borne out by the fact that these woods are used interchangeably for all purposes. The difference from the buyers' viewpoint is largely a matter of selection of grades and sizes, depending on their availability.

Idaho white pine in northern Idaho, the optimum of its geographical range, is found on moderate slopes and flats at elevations varying from 2,000 feet to 5,000 feet above sea level. At these elevations it grows fairly slowly and develops straight-grained wood which is free from pitch and of soft and uniform texture. Its color is a pale cream to light reddish-brown, the darker tones being found usually on pieces that have darkened slightly on exposure to sunlight.

The grain is delicately figured and inconspicuous as there is a gradual change from springwood to summerwood so that the summerwood (annual ring or grain) is not sharply defined. This condition accounts in part for its selection for foundry pattern work where ease in working is an important factor. The wood is light in weight, comparatively strong for its weight, changes very little under varying atmospheric conditions, saws and planes easily, shows no tendency to split when nailed, stays in place, glues well, and has the preference for enameled and painted work. It is thoroughly seasoned before it is shipped from the mill and is surfaced to standard sizes *after* drying. The average Idaho white pine log produces lumber which is free from shake, and runs strongly to pieces of the small tight-knotted type. On that account a large assortment of high quality common lumber is always available in a variety of grades and sizes.

Idaho white pine is sometimes called a cousin of the northern white pine, which it so closely resembles that there is difficulty in separating the two species. Experienced lumbermen sometimes can distinguish them by the variations in knot formations, or by color. Pattern makers claim to be able to separate the two species by their difference in workability.

TABLE 122

PROPERTY VARIATIONS

Idaho White Pine	*Northern White Pine*
White to light-brown heartwood.	Heartwood white to pale straw color.
Sapwood white.	Lighter than Idaho white pine.
Slightly heavier than northern white pine.	Slightly stronger than Idaho white pine.
Slightly stiffer than northern white pine.	Slightly softer.
Slightly harder.	Dries easily and holds shape well.
Tends to cup and twist more than northern white pine.	Little shrinkage.
Shrinks and swells more with changes in moisture content.	Less resinous than Idaho white pine.
Slightly more resinous.	

Uses

The uses to which Idaho white pine are put follow very closely those given for northern white pine. It is the preferred lumber for outside finish including such items as siding, exterior trim, cornice and porch material, moldings, and the like. It also is used for screens, shutters, sash, doors, window frames, knotty and enameled paneling, turned stair work, carvings, casing and base, and moldings of all types. Industrial uses include foundry patterns and flasks, matches, drawing boards, picture and mirror backing, boxes and crates, shade and map rollers, organ pipes, piano keys, toys and wood novelties, store fixtures, shelving, trunks, drawer bottoms, caskets, boats, and farm buildings.

Classifications

Detailed information regarding the grades, sizes, shipping and inspection provisions for Idaho white pine are found in the Standard Grading Rules of the Western Pine Manufacturers Association and the California White and Sugar Pine Association.

(See general list of Associations for addresses.)

The following grades are available in 4/4 and thicker sizes and in the selects and commons, and may be ordered in specified widths and lengths, or random widths and lengths:

B Select and Btr.	B and Btr. Siding
C Select	C Siding
D Select	D Siding
No. 1 Common	E Siding
No. 2 Common	Colonial Siding
No. 3 Common	Standard Moldings
No. 4 Common	Box
No. 5 Common	No. 1 Lath
No. 3 and Btr. Shop	No. 2 Lath

In specifying the grades of Idaho white pine shown above the buyer should not become confused after considering the grade terms of other species and form the opinion that grades are comparable between species. The inherent qualities of the woods, the difference in the character of the natural defects, and the suitability of the woods for certain purposes preclude such an arrangement. In addition the grade divisions are not the same in all woods. This is particularly true in the case of common lumber where there is the widest variation in the quality of a board of the highest common grade and one of the lowest. Idaho white pine grade divisions follow American Lumber Standards. Coast fir and other West Coast woods and redwood are segregated into three common grades; southern yellow pine and cypress into four common grades. From this difference alone it is logical to expect, and the statement will be borne out by fact, that No. 1 common Idaho white pine will contain pieces that fall within narrower grade limits and average of a higher type than a corresponding grade of the other species named. A better index of comparability is selling price, the grades of the different woods that fall within the same price zone being more nearly of equal values.

Types and Sizes

See pages 15 to 19 of the Standard Grading Rules mentioned above; also Tables 6, 7, 8, 16, 18 in this volume.

Unit Packages

Idaho white pine lumber is sold on board feet basis as is also fabricated and patterned stock.

Shipping Weights

TABLE 123

WESTERN PINE MANUFACTURERS ASSOCIATION—IDAHO WHITE PINE

Kind of Stock	*Weight per 1,000 bd. ft.*
4/4 Common and shop S2S	1,900 lbs.
4/4 Common shop and selects, rough	2,400 lbs.
4/4 Common and selects, pattern	1,700 lbs.
4/4 Selects S2S	1,900 lbs.
Thick common shop, selects S2S	2,300 lbs.
Thick common, rough	2,600 lbs.
Bevel siding	800 lbs. (25/32″)
Finish	1,900 lbs.
Ceiling—5/8″ finished to 9/16″	1,700 lbs.
Drop and rustic 1″	1,700 lbs.
Shiplap	1,700 lbs.

Ordering

Specify the use for which the stock is desired; also moisture content, grade and quantity.

(See also general discussion on ordering.)

Caution

In ordering Idaho white pine it should be remembered that the most important uses for this stock are for planing mill products, etc., which require factory grades. Such material generally is kiln-dried and shipped by rail. Special attention should be given moisture content.

Special Service Requirements

It is well to bear in mind that this species is light and soft and is not adapted for use where strength is required. It is, however, quite resistant to decay and for exterior construction use such as shingles, siding, and sheathing it can be used with excellent results.

Dense grades are not available in this species.

Specifications

The following publications give information on specifications:

Lumber—Simplified Practice Recommendation—Bureau of Standards.
Standards and Specifications in the Wood-Using Industries—Bureau of Standards.
National Directory of Commodity Specifications—Bureau of Standards.

(See general Bibliography for publishers' addresses.)

Engineering Data

(See Table 2.)

Improvements

(See general discussion on this subject.)

Associations

The following associations will be glad to give information regarding lumber and other stock cut from Idaho white pine:

Western Pine Manufacturers Association.
National Lumber Manufacturers Association.

(See general list of Associations for addresses.)

Publications

The following publications frequently carry trade items regarding Idaho white pine:

American Builder
American Lumberman
American Woodworking Review
Building Material Merchant
California Lumber Merchant
Crow's Pacific Coast Lumber Digest
Four L Lumber News
Lumber Co-Operator
National Lumberman
Lumber Trade Journal
National Retail Lumber Dealer
New York Lumber Trade Journal, The
Millwork
Mississippi Valley Lumberman
Retail Lumberman
Retail Lumber Trade News
Timberman, The
Veneers
West Coast Lumberman
Western Retail Lumberman
Western Wood Worker and Furniture Manufacturer
Weyerhæuser Log
Wood Workers Clearing House Journal
Wood Construction
Wood Preserving News
Wood-Worker, The
Wood Working Industries

(See general list of Periodicals for publishers' addresses.)

Bibliography

The following books and articles may prove helpful to readers desiring further information:

Idaho Forest and Timber Handbook—University of Idaho.
Check List of the Forest Trees of the United States—George B. Sudworth.
American Forest Trees—Henry H. Gibson.
Lumber and Its Uses—R. S. Kellogg.

(See general Bibliography for publishers' addresses.)

Abbreviations and Terminology

Ida. wh. pine—Idaho white pine
W. w. pine—Western white pine
West. wh. pine—western white pine

(See general list of Abbreviations and Glossary.)

NORTHERN WHITE PINE

(A Softwood)

Pinus strobus

ANNUAL PRODUCTION (1928) ..... 837,907,000 bd. ft.
AVERAGE VALUE OF LUMBER CUT AT MILL PER M. B. F. (1928) $30.22
TIMBER STAND (1925) (Estimated) ..... 23,457,000,000 bd. ft.

PRINCIPAL STATES PRODUCING CUT—IN ORDER OF IMPORTANCE (1928):

Minnesota, New Hampshire, Wisconsin, Massachusetts, Michigan, New York, Vermont, Pennsylvania

Range of Species

From Newfoundland (White Bay region) and along the northern shores of St. Lawrence Gulf to northern Ontario (near Abbitibi and Nipigon lakes) and southern Manitoba (near southern end of Lake Winnipeg); also in central Manitoba north of Lake Winnipeg at points northeast and northwest of Lake Sipiwesk, southward through northern and eastern Minnesota, central and southeastern Iowa, northern (counties) Illinois, southern shore of Lake Michigan, southern Michigan (north of Allegan, Eaton, and St. Clair counties. Once dominant as far south on the west as north border of Van Buren County), northeastern and eastern (border counties) Ohio, and along the Allegheny Mountains to northern Georgia (Tallulah Falls).

Usual Name

Northern white pine

Also Called

White pine (Me., N. H., Vt., Mass., R. I., Conn., N. Y., N. J., Pa., Del., Va., W. Va., N. C., Ga., Ind., Ill., Wis., Mich., Minn., Ohio, Ontario, Neb.)
Cork pine (Mich.)
Weymouth pine (Mass., S. C.)
Soft pine (Pa.)
Northern pine (S. C., trade)
Spruce pine (Tenn.)
Balsam pine (N. C.)
Apple pine
Sapling pine
Pumpkin pine (Mich., trade)
Canadian white pine (trade)
Soft white pine (trade)
Northern white pine (trade)
Wisconsin white pine (trade)
Soft cork pine (trade)
Minnesota white pine (trade)
Soft Minnesota white pine (trade)
Eastern white pine (trade)

Description

Northern white pine is one of the favorite construction woods of America. It has been employed for a great variety of uses since the founding of this country.

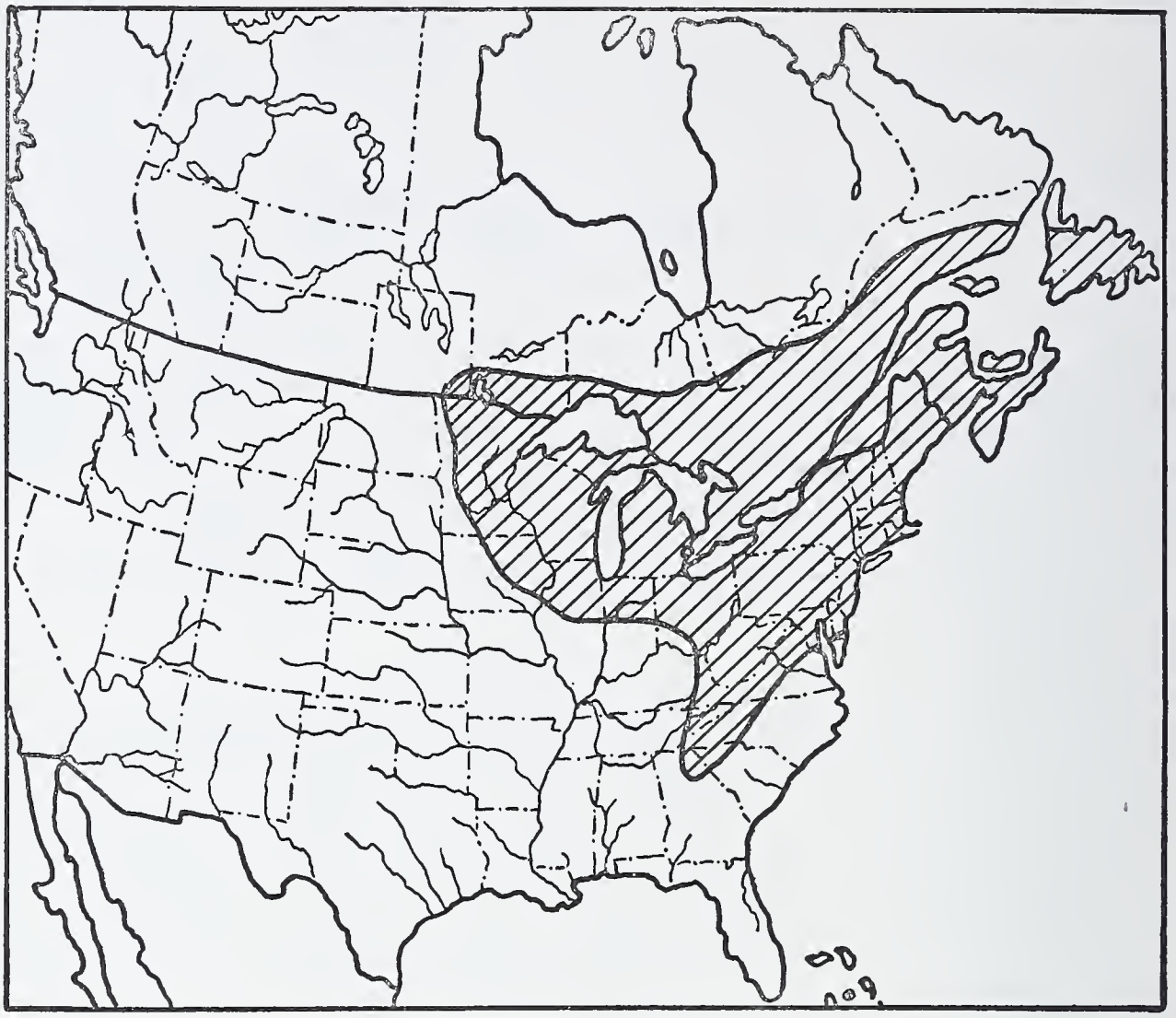


Illustration 53—General range of northern white pine.

Formerly, enormous stands of white pine stretched across the famous "white pine belt" in the northern part of the present range. It has been made famous in lumbering lore since the olden logging days in Minnesota, Michigan, and certain northeastern states. It is usually found on sandy, gravelly, or granite soils, where it reaches its best development.

Heartwood of white pine varies in color from cream white or a pinkish cast to gray. The sapwood is nearly white.

The wood seasons easily and does not shrink and is resistant to changes in moisture content, thus minimizing warping and twisting.

Virgin growth timber is fine-grained, even in texture, and soft. The wood is resinous but is the best of any of the pines. It is also one of our lightest commercial species, and while not exceedingly strong it compares favorably, weight for weight, with other soft woods. It grows rapidly. Second growth timber is in nowise comparable to the virgin growth, being coarser-grained and knotty, and it is not as soft. Because of its close grain and freedom from objectionable acids and oils, it takes paint, stains, varnishes, and enamel perfectly.

The wood polishes well, can be easily cut, and glues well.

Northern white pine is often spoken of as eastern white pine, but it is also known in various regions under other trade names, listed above. Often Norway pine (sometimes

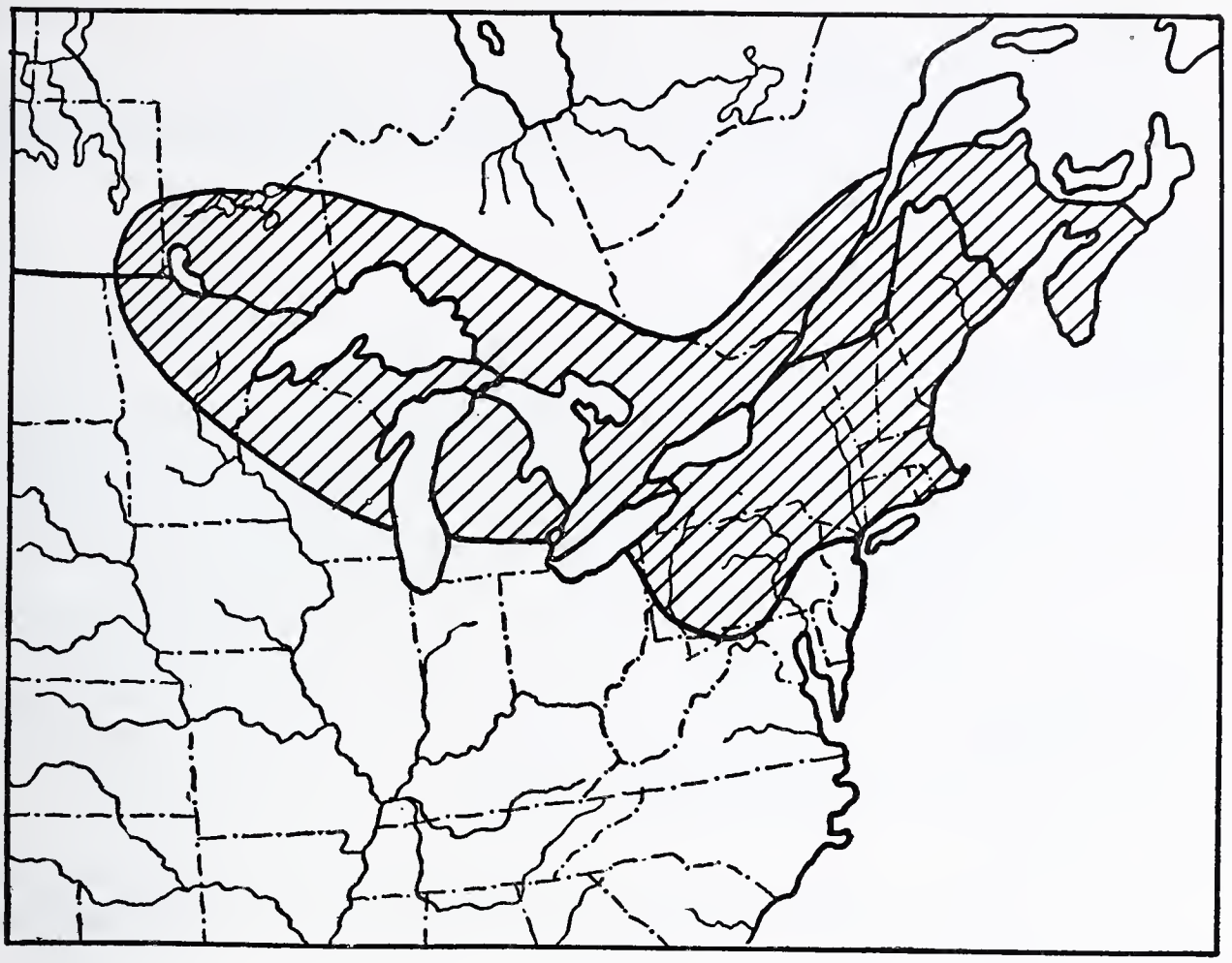


Illustration 54—General range of Norway pine.

called red pine) is mixed in with northern white pine and sold under the name eastern white pine. Norway pine is similar in its characteristics to northern white pine, except for the red tinge of the heartwood. Norway pine is slightly coarser-grained, stronger, has wide, light-colored sapwood, and is inclined to be somewhat brash.

Uses

Northern white pine is an "all-universal" wood. Formerly it went into masts and matches, and into almost every shape and size product between these two. It is a favorite in building and construction, for both interior and exterior use. Millions of feet are used annually in the box and container industry.

It is said that over 50 per cent of the cut of northern white pine is now used in planing mill products. It is also a favorite pattern lumber. Among the products of importance for which it is now used are blinds, doors, sash, boxes and crates, containers, matches, rollers, woodenware novelties, caskets and coffins, molding stock, siding, tank stock, interior knotty pine paneling, cornices, kitchen cabinets, sheathing, etc.

Classifications

For detailed information regarding specifications, grading rules, etc., consult:

Grading Rules for Northern White and Norway Pine, Spruce, and Tamarack—Northern Pine Manufacturers Association

Grades of Northern White Pine as Made in the Tonawandas—White Pine Association of the Tonawandas

Grading Rules for Rough Spruce, Balsam, Jack Pine, Red Pine, and Hemlock—Adopted March 17, 1926, Montreal Wholesale Lumber Dealers' Association

(See general list of Associations for addresses.)

Types and Sizes

(See Tables 5, 6, 7, 8, 16, 18.)

Unit Packages

Rough lumber is sold on the basis of 1,000 board feet measure.

Surface stock and cut-to-pattern stock, sold on board foot basis; also lineal feet basis. Measurement is made on corresponding standard dimension of rough green stock, or stock of standard rough size necessarily used in its manufacture. "On lumber of standard thicknesses less than 1″ (board measure), the board feet measurement shall be based on the surface dimension" (Grading Rules for Northern White and Norway Pine, etc.)

Stock sizes are tallied by the number of pieces of each width, thickness, and length in the shipment.

Stock thicker than 1″ is tallied as 1″, multiplied by thickness as expressed in inches and fractions of an inch.

In bundled stock each length is bundled separately.

Shipping Weights

The following data pertain to approximate shipping weights of rough lumber, surfaced lumber, and other products, based upon computations of the Northern Pine Manufacturers Association:

TABLE 124

Comparative Shipping Weights of Northern White Pine and Norway Pine

Kind of Stock	*Weight per 1,000 board feet*		
	Green[1]	*Half-Dry*[2]	*Dry*[3]
2″, Rough or S1E	4,000 lbs.	2,900 lbs.	2,500 lbs.
2 x 14, S1S1E	3,700 lbs.	3,300 lbs.	3,000 lbs.
2″, S1S1E, S4S, D and M	3,000 lbs.	2,500 lbs.	2,200 lbs.
3″, and 4 x 4 to 8 x 8	4,000 lbs.	3,500 lbs.	3,000 lbs.
Common Boards, rough	4,000 lbs.	2,900 lbs.	2,400 lbs.
Common Boards, S1S or S2S	2,900 lbs.	2,400 lbs.	2,000 lbs.
Fencing, rough	4,000 lbs.	2,900 lbs.	2,400 lbs.
Fencing, S1S or S2S	2,900 lbs.	2,400 lbs.	2,000 lbs.
Drop Siding, Gr. roofing	2,600 lbs.	2,200 lbs.	1,800 lbs.
Shiplap and D. and M	2,600 lbs.	2,200 lbs.	1,800 lbs.
3/8 Lath, Norway	850 lbs.	650 lbs.	500 lbs.
3/8 Lath, white pine	800 lbs.	600 lbs.	450 lbs.
3/8 Ceiling and Bevel Siding	....	....	800 lbs.
Finishing, S1S or S2S	....	....	2,000 lbs.
Sheathing Lath	....	....	1,500 lbs.
5/8 Ceiling	....	....	1,500 lbs.
1/2″ Flat Battens	....	....	800 lbs.
O. G. Battens	....	....	1,500 lbs.
Pickets, rough	....	....	2,400 lbs.
Pickets, D and H	....	....	1,400 lbs.
Shingles	....	....	250 lbs.

[1] Green from saw. [2] 12 to 25% moisture content. [3] 7 to 12% moisture content.

Ordering

Specify clearly amount, thickness, width, length, and grade desired.

If stock is to be surfaced or cut to pattern, specify clearly kind desired (specify, if possible, American Lumber Standards).

Specify clearly whether yard or factory lumber is wanted.

Caution

Finish, siding, flooring, ceiling, partition, shiplap, D & M, grooved roofing, dimension, and lath are considered yard lumber.

Dense or structural grades are not available in this species, but dimension and timbers may be obtained, mostly in Norway pine.

Factory grades are specified for stock to be recut for cuttings.

Unless otherwise clearly specified in order, Norway pine can be included in shipment. For many purposes this species will serve as well as northern white pine.

Note particularly that pieces under the normal size are permissible in surfaced lumber.

Special Service Requirements

Northern white pine is now more or less a specialized wood. Western "soft" pines are taking its place for many purposes, notably planing mill products. In the East northern white pine can be obtained in any quantity or size, grade, etc., as specified in grading rules.

It is well, when ordering, to specify the exact purpose for which stock is to be used. Often considerable savings to the consumer are made through the substitution of another grade which may be just as serviceable.

Specifications

The following publications may be consulted for information regarding specifications for northern white pine:

Lumber—Simplified Practice Recommendation—Bureau of Standards.
Standards and Specifications in the Wood-Using Industries—Bureau of Standards.
National Directory of Commodity Specifications—Bureau of Standards.

(See general Bibliography for publishers' addresses.)

Engineering Data

(See Table 2.)

Improvements

Grading rules for this species have been revised from time to time, unifying the grading of northern white and Norway pine lumber.

There is constant effort to remove discrepancies in rules and give the consumer lumber which is in compliance with these rules.

Better manufactured and finer finished products are constantly being produced, with particular reference to surfacing, matching, pattern, etc.

Where possible, revisions have been made in order to comply with American Lumber Standards. A few exceptions are to be found (consult Grading Rules for Northern White and Norway Pine, etc., under standard dressed sizes for lumber).

Producers are kiln-drying lumber to a greater extent than ever before, and better facilities for shipment are being devised.

Associations

The following associations are glad to give information regarding lumber and other stock cut from northern white pine:

Northern Pine Manufacturers Association.
White Pine Association of the Tonawandas.
Montreal Wholesale Lumber Dealers' Association.

(See general list of Associations for addresses.)

Publications

The following publications frequently carry trade items regarding white pine, prices, and other data:

American Builder
American Lumberman
American Woodworking Review
Gulf Coast Lumberman
Lumber Co-Operator
National Lumberman
Lumber Trade Journal
National Retail Lumber Dealer
New York Lumber Trade Journal, The
Millwork
Mississippi Valley Lumberman
Retail Lumberman
Retail Lumber Trade News
Southern Lumberman
Veneers
Wood Workers Clearing House Journal
Wood Construction
Wood Preserving News
Wood-Worker, The
Wood Working Industries

(See general list of Periodicals for publishers' addresses.)

Bibliography

The following books and articles may prove useful to readers desiring further information:

The White Pine—V. M. Spaulding.
Norway Pine in the Lake States—Forest Service.
The Forest Trees of Ontario—J. H. White.
Forest Trees of Wisconsin—F. G. Wilson.
Common Trees of New York—Jos. S. Illick.
Lumber and Its Uses—R. S. Kellogg.
Handbook of the Trees of the Northern States and Canada, East of the Rocky Mountains—R. B. Hough.
American Forest Trees—Henry H. Gibson.
Check List of Forest Trees of the United States, Their Names and Ranges—U. S. Dept. of Agriculture.

(See general Bibliography for publishers' addresses.)

Abbreviations and Terminology

White pine is commonly abbreviated as W. P.; also E. W. P.—eastern white pine.

(See general list of Abbreviations and Glossary.)

PONDOSA PINE OR CALIFORNIA WHITE PINE[1]

(A Softwood)

Pinus ponderosa

ANNUAL PRODUCTION (1928) ..... 3,000,000,000 bd. ft.
AVERAGE VALUE OF LUMBER CUT AT MILL PER M. B. F. (1929) $26.17
TIMBER STAND ..... 250,000,000,000 bd. ft.

PRINCIPAL STATES PRODUCING CUT—IN ORDER OF IMPORTANCE:

Oregon, California, Washington, Idaho, Montana, Arizona, New Mexico, South Dakota, Colorado.

Range of Species

Timber of this species is found in commercial quantities over a greater area in western United States than any other species. It grows in the drier, high plateau country lying between the Rockies and the Cascades and the Sierra Nevadas extending from Canada to Mexico.

Producing Districts

One distinct producing district is the Inland Empire of the Pacific Northwest, where more than 50 per cent of the entire annual production of this species is manufactured. The Inland Empire embraces western Montana, Idaho, eastern Washington and eastern Oregon. Adjoining it to the north is the group of manufacturers in southern British Columbia. To the south lies the district of southern Oregon and northern Columbia. A third producing district in the United States is southern Colorado, Arizona, and New Mexico, and a fourth and much smaller group of manufacturers of this species of pine are to be found in the Black Hills section of South Dakota. In each of these districts, which in the beginning of their manufacturing operations served principally to supply lumber for local markets, there sprang up local names for the wood. Because of its similarity in texture to eastern or northern white pine the term "white pine" was usually used together with a territorial designation. As the market for this lumber broadened, shipments from all of these major producing districts met in some eastern center but the lumber was still sold under its own local name. Even in the Inland Empire there was not complete uniformity of name until 1924 when the term Pondosa pine (a contraction of the scientific name) was selected by the producers in that region. Its use is growing steadily, and has been accepted by many producers in California, southern Oregon, the southwest, South Dakota and British Columbia, and bids fair to supplant the other local names in most national markets within a short time.

[1] The term "California white pine" is used by mills in southern Oregon and California to refer to the lumber of the species Pinus ponderosa, which they manufacture. In the Forest Service this species is called western yellow pine.

Illustration 55—General range of western yellow (Pondosa, California white) pine.

Usual Names

Pondosa pine
California white pine
Arizona white pine
New Mexico white pine

Also Called

Western yellow pine
Yellow pine (Calif., Mont., Col., Idaho, Utah, Wash., Ore., Neb.)
Bull pine (Calif., Wash., Utah., Idaho, Ore., Col.)
Big pine (Mont.)
Long-leaved pine (Utah, Nev., Col.)
Red pine
Pitch pine
Heavy-wooded pine (Eng.)
Western pitch pine
Heavy pine (Calif.)
Foothills yellow pine
Sierra brownbark pine
Montana black pine (Calif., lit.)
"Gamblers'—Perry's Pine" (Eng., lit.)
Rocky Mountain yellow pine (lit.)
Mexican pine (New Mex.)
Western soft pine (trade)
Western white pine (trade)
Oregon white pine (trade)
Oregon pine (trade)
Western pine (trade)
Arizona soft pine (trade)
Ponderosa pine (nursery, trade)

Description

Pondosa pine lumber, as has been mentioned, closely resembles eastern or northern white pine, which for years has been the preferred softwood for building. In fact no other wood which is not a genuine white pine resembles it to a greater degree. As a consequence, Pondosa pine has been used for most of the same purposes with entire satisfaction during the past twenty-five years.

Pondosa, like the white pines or soft-textured pines, with which it is grouped, is a finishing wood primarily, because of its fine, soft, and easily-worked structure. It will vary in texture and grain more than the white pines and some have been led to believe that this is due entirely to conditions in a particular locality where it grows. In reality the difference lies in the age of the trees that are cut, and the rapidity of their growth. A small, fast growing tree will have coarser-grained, harder-textured wood than a large, slow growing tree which will produce very soft-textured, fine-grained lumber. In trees of normal growth the center portion will show coarser grain than the outer zone and this is cut into the lower grades of lumber. The young, fast growing (coarser-grained) trees are found in all districts where this tree grows. In the same way soft-textured, old growth trees are found in all localities in the commercial range of this species. By far the greater proportion of the latter kind are logged in each district.

Uses

Because this wood is considered one of our most important commercial species its uses are greatly diversified. It is an important construction wood and is used for many types and sizes of building and construction material.

One of the most important uses is in the manufacture of sash, doors, interior finish, and general millwork. The poorer grades and quality are used for boxes and crates, crossties, etc.

Classifications

For detailed information regarding specifications, grading rules, etc., consult *Standard Grading Rules for Pondosa Pine, California White Pine, Idaho White Pine, etc.*, published by Western Pine Manufacturers Association and California White and Sugar Pine Association.

(See general list of Associations for addresses.)

Types and Sizes

Standard manufactured sizes are to be found on page 15 of the Standard Grading Rules and drawings of standard patterns on pages 62, 63 and 64. See also Tables 6, 7, 8, 15, 16, 18 in this volume.

Unit Packages

Rough lumber is sold on a board feet basis. (Refer to paragraphs on measurement and tally on page 6 of the Standard Grading Rules.)

TABLE 125

WESTERN PINE MANUFACTURERS ASSOCIATION—PONDOSA PINE

Kind of Stock	*Weight per 1,000 Bd. Ft.*
4/4 Common and shop S2S	2,100 lbs.
4/4 Common shop and selects, rough	2,600 lbs.
4/4 Common and selects, pattern	1,800 lbs.
4/4 Selects S2S	2,000 lbs.
Thick common, shop, selects S2S	2,400 lbs.
Thick common, rough	2,800 lbs.
Bevel siding	800 lbs.
Lath	500 lbs.

TABLE 126

CALIFORNIA WHITE AND SUGAR PINE MANUFACTURERS ASSOCIATION—CALIFORNIA WHITE PINE

Kind of Stock	*Net Thickness, Inches*	*Weight per 1,000 Bd. Ft.*
Rough	....	2,400 lbs.
S1S, S2S or S4S	3/4	1,800 lbs.
4/4	25/32	1,900 lbs.
	13/16	1,950 lbs.
	7/8	2,100 lbs.
5/4	1 5/32	2,200 lbs.
6/4	1 13/32	2,250 lbs.
8/4	1 25/32	2,150 lbs.
	1 13/16	2,200 lbs.
Over 8/4	....	2,200 lbs.
Siding	3/16 x 7/16	600 lbs.
Siding	5/8	800 lbs.
Colonial siding	3/4	1,200 lbs.
Panel	1/2	1,200 lbs.
Panel	5/8	1,500 lbs.
Panel	3/8	900 lbs.
Panel	7/16	1,050 lbs.
Panel	9/16	1,350 lbs.
Panel	11/16	1,550 lbs.
Dimension	1 9/16	1,900 lbs.
	1 5/8	1,950 lbs.
	1 3/4	2,100 lbs.

TABLE 127

COMPARATIVE SHIPPING WEIGHTS OF CALIFORNIA WHITE PINE AND PONDOSA PINE

Kind of Stock	*California White Pine (Weights for Statistical Purposes) Lbs. per 1,000 Bd. Ft.*	*Pondosa Pine (Estimated Shipping Weights) Lbs. per 1,000 Bd. Ft.*
Finish	1,900	2,000
Flooring, 25/32" x 2 3/8"	....	2,000
Ceiling, 5/8" finished to 9/16"	1,500	1,800
Siding, bevel	600	800
Boards, finished 25/32"	1,900	2,100
Boards, rough	2,400	2,600

Ordering

(See general discussion on this subject.)

Caution

When purchasing this kind of lumber it must be borne in mind that there are several names in common use in the trade for the same wood. In other words, specify California white pine, Pondosa pine, etc., or add the words "Pinus ponderosa" when writing an order.

The California White and Sugar Pine Manufacturers Association, or the Western Pine Manufacturers Association, will be glad to give assistance in straightening out any confusion regarding the types of pine that will work to best advantage. They also will be glad to furnish other information concerning this species.

Special Service Requirements

Pondosa pine has many favorable properties which make it ideal for certain specialized purposes, as already noted. It is available in a multitude of sizes and grades and is considered one of the most diversified and abundant species.

Specifications

The following may be consulted for information on specifications:

Lumber—Simplified Practice Recommendation—Bureau of Standards.
Standards and Specifications in the Wood-Using Industries—Bureau of Standards.
National Directory of Commodity Specifications—Bureau of Standards.

(See general Bibliography for publishers' addresses.)

Engineering Data

(See Table 2.)

Improvements

(See general discussion under this heading.)

Associations

The following associations will be glad to give information regarding lumber and materials cut from Pondosa pine and California white pine:

California White and Sugar Pine Manufacturers Association.

Western Pine Manufacturers Association.

(See general list of Associations for addresses.)

Publications

The following publications frequently carry trade items regarding Pondosa pine and California white pine:

American Builder
American Lumberman
American Woodworking Review
Building Material Merchant
California Lumber Merchant
Crow's Pacific Coast Lumber Digest
Four L Lumber News
Lumber Co-Operator
National Lumberman
Lumber Trade Journal
National Retail Lumber Dealer
New York Lumber Trade Journal, The
Millwork
Mississippi Valley Lumberman
Retail Lumberman
Retail Lumber Trade News
Timberman, The
Veneers
West Coast Lumberman
Western Retail Lumberman
Western Wood Worker and Furniture Manufacturer
Weyerhæuser Log
Wood Workers Clearing House Journal
Wood Construction
Wood Preserving News
Wood-Worker, The
Wood Working Industries

(See general list of Periodicals for publishers' addresses.)

Bibliography

The following books and articles may prove useful to readers desiring further information:

Sugar Pine and Western Yellow Pine in California—A. W. Cooper—Forest Service Bulletin No. 69.
Western Yellow Pine in Oregon—T. T. Munger—Forest Service Bulletin No. 418.
Western Yellow Pine Car Sills, Joists and Small Clear Piece—U. S. Dept. of Agriculture Bulletin No. 497.
Western Yellow Pine in Arizona and New Mexico—Theodore S. Woolsey, Jr.—Forest Service Bulletin No. 101.
Check List of the Forest Trees of the United States, Their Names and Ranges—George B. Sudworth—Misc. Circular No. 92, U. S. Dept. of Agriculture.
American Forest Trees—Henry H. Gibson.
Lumber and Its Uses—R. S. Kellogg.

(See general Bibliography for publishers' addresses.)

Abbreviations and Terminology

P. P. or Pondosa—Pondosa Pine
C. W. P.—California white pine

(See general list of Abbreviations and Glossary.)

THE SOUTHERN PINES[1]

(Softwoods)

ANNUAL PRODUCTION (1928).....10,610,290,000 bd. ft.
AVERAGE VALUE OF LUMBER AT MILL PER M. B. F. (1928).....$24.62
TIMBER STAND (1920).....459,000,000,000 bd. ft.

PRINCIPAL STATES PRODUCING CUT—IN ORDER OF IMPORTANCE (1928):

Mississippi, Alabama, Louisiana, Texas, Georgia, Florida, North Carolina, Arkansas, South Carolina, Virginia, Oklahoma.

Range of Species

LONGLEAF PINE

Pinus palustris

Coast region from southeastern Virginia (Norfolk) to southern Florida (Indian and Calloosahatchee rivers) and westward to eastern Texas (Trinity River); to northwestern Georgia, northward in Alabama to the northern part of the state (Clary, Fayette, Walker, and Winson counties), central and western Mississippi (Adams, Hinds, Newton, and Kemper counties), and in western Louisiana (almost reaching the north line of the state).

LOBLOLLY PINE

Pinus tæda

South Atlantic and Gulf states from New Jersey (Cape May), southern Delaware, eastern Maryland, and North Carolina (Polk County), to central Florida (Cape Malabar and Tampa Bay); west to eastern Texas (Colorado River; in Bastrop County); northward into southwestern Oklahoma, southwestern Arkansas, and the southern border of middle and west Tennessee.

SHORTLEAF PINE

Pinus echinata

From New York (Long Island and Staten Island), to Florida (Chattahoochee region), and west through West Virginia, southwestern Illinois (northwestern Union County), and eastern Tennessee to southern Missouri, southwestern Arkansas, southeastern Oklahoma (Black Fork Mountain), and eastern Texas.

Note on Nomenclature.—Formerly designated as Pinus mitis michaux

[1] The southern pines herein discussed form the bulk of the supply of southern pine lumber.

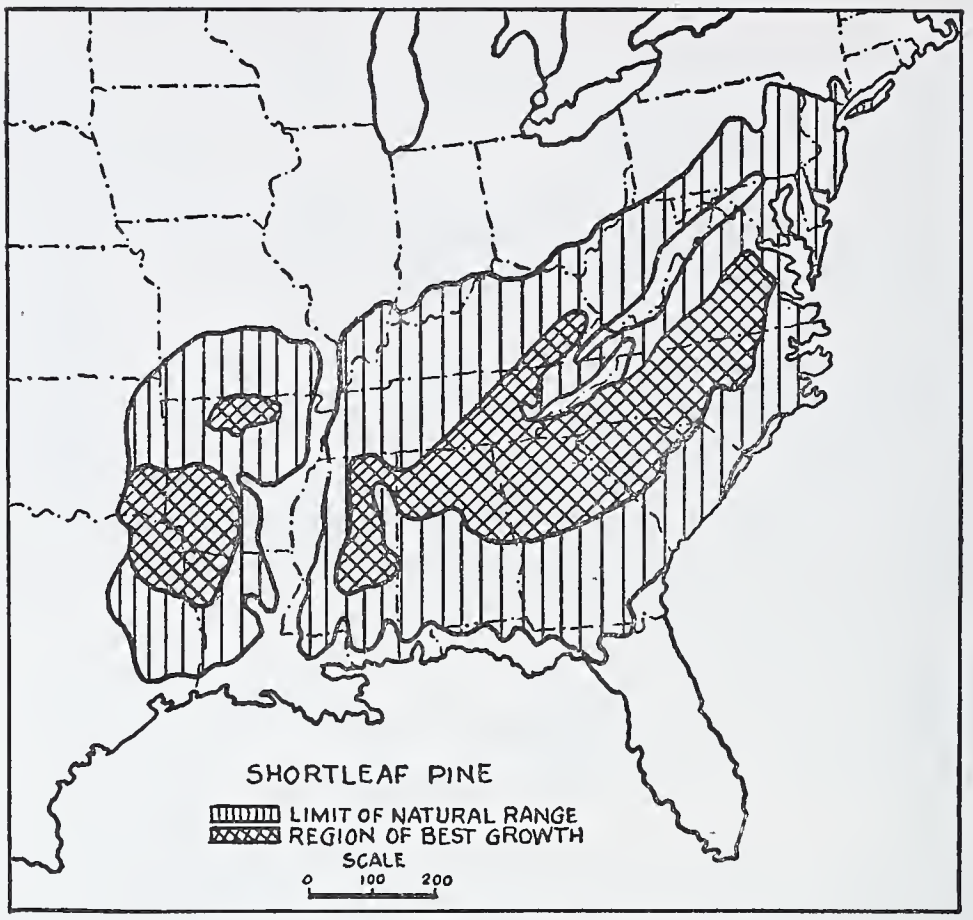


Illustration 56—General range of shortleaf pine.

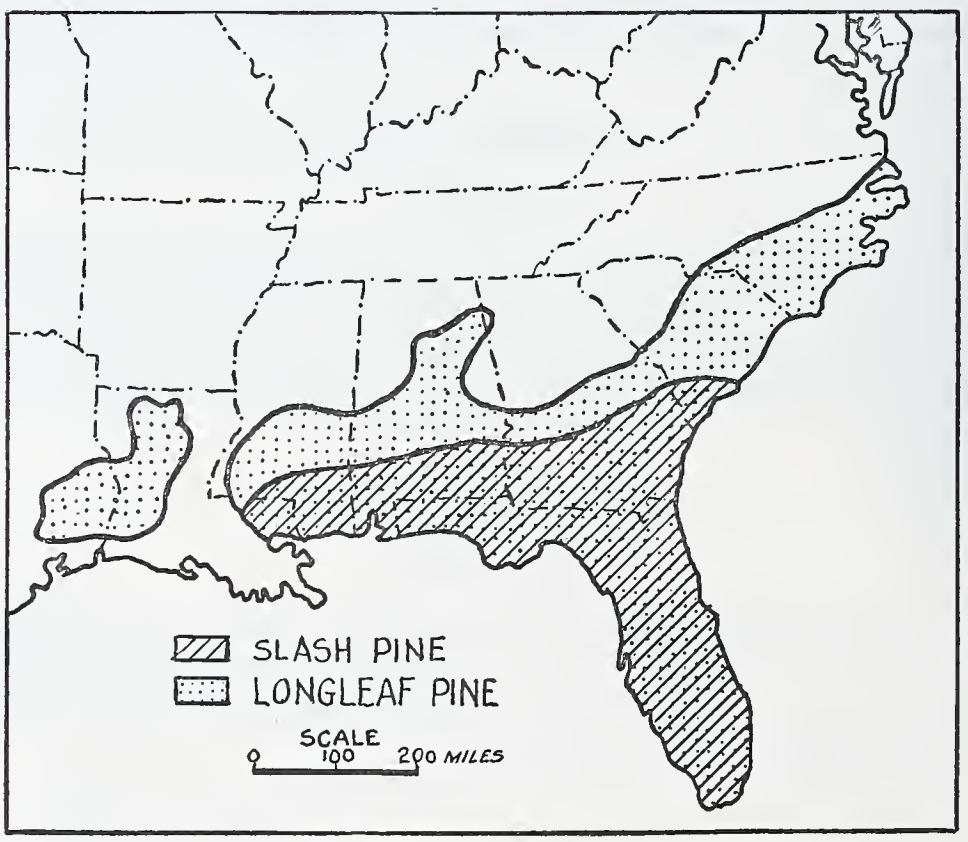


Illustration 57—General ranges of slash and longleaf pines.

VIRGINIA PINE

Pinus virginiana

From New Jersey (central and southern) and Pennsylvania (central, southern, and western) to Georgia and northern Alabama (Winston, Cullman, and Dekalb counties); west into Ohio, southern Indiana, Mississippi (northeastern), and middle Tennessee (Putnam County); Arkansas (Carroll County), on Ozark Mountains.

Note on Nomenclature.—Formerly designated as Pinus inops solander

POND PINE

Pinus rigida serotina

Coast region from New Jersey (vicinity of Cape May) and southeastern Virginia to Florida (head of St. Johns River, and probably farther south; on the west coast of Florida from Pensacola to Osceola County and probably much farther south). Range imperfectly known.

Note on Nomenclature.—Formerly designated as Pinus serotina michaux

SPRUCE PINE

Pinus glabra

Coast region from South Carolina (Santee River) to central and northwestern Florida (Chattahoochee region) and west to southeastern Louisiana.

SLASH PINE

Pinus caribæa

Coast region (60 to 100 miles inland) from South Carolina to southern Florida (Keys); westward in the coast region (in Alabama up to Dallas and Washington counties) of the Gulf states to eastern Louisiana (Washington, St. Tammany, eastern Livingston, and southern Tangipahoa parishes). Occurs also in Honduras, eastern Guatemala, Bahamas, Cuba, and Isle of Pines.

Note on Nomenclature.—Formerly designated as Pinus cubensis grisebach, and as Pinus heterophylla (Elliott) Sudworth, and as Pinus elliottii engelmann.

Usual Names

There is, perhaps, no one group of varieties which is more badly confused than the various pines, which are sold in the trade under a multitude of names and are referred to as "the southern yellow pines." The following table will serve as a guide in designating approved trade names for this group:

TABLE 128

THE SOUTHERN YELLOW PINES GROUP

Common Name of Tree	*Scientific Name of Tree*	*Other Names of Tree in use (See "Also Called")*	*Commonly Accepted Trade Name of Lumber*	*Commercial Source of Lumber*
LONGLEAF PINE[1]	Pinus palustris	Georgia pine Dense pine Pitch pine Florida longleaf pine Georgia yellow pine Longleaved pine Southern hard pine Florida pine	*Domestic* Longleaf pine *Export* Pitch pine Southern pine[1]	Louisiana Florida Mississippi Oklahoma Georgia Texas
LOBLOLLY PINE[1]	Pinus tæda	Shortleaf pine Shortstraw pine Old field pine Second growth pine Southern yellow pine	*North Carolina pine*[1] Arkansas soft pine Also: Southern pine[1] Sap pine	North Carolina Georgia Mississippi Alabama Louisiana Arkansas Texas Virginia
SHORTLEAF PINE	Pinus echinata	Rosemary pine Shortleaved pine Shortleaved yellow pine Arkansas shortleaf pine Southern pine Southern yellow pine Old field pine, etc.	*Arkansas soft pine*[1] *North Carolina pine*[1] Also: Southern pine[1] Shortleaf yellow pine	North Carolina South Carolina Georgia Mississippi Alabama Louisiana Arkansas Texas Virginia
VIRGINIA PINE	Pinus virginiana	Spruce pine Scrub pine Alligator pine	*North Carolina pine*[1] Also: Shortleaf pine	North Carolina Virginia Georgia Tennessee
POND PINE	Pinus rigida serotina	Pond pine Pocasin pine (North Carolina) Black bark pine Southern pine	*Southern pine*[1]	North Carolina South Carolina Mississippi Florida Georgia
SLASH PINE	Pinus caribæa	Scrub pine	*Southern pine*[1]	Florida Alabama Mississippi Georgia
SPRUCE PINE	Pinus glabra	Southern white pine	*Southern pine*[1]	South Carolina Florida Georgia Louisiana Alabama

[1] Preferred trade names which are commonly used in designating lumber cut from these species.

Also Called

Longleaf Pine:

Longleaved pine (Va., N. C., S. C., Ga., Ala., Fla., Miss., La., Tex.)
Southern pine (N. C., Ala., Miss., La., and trade.)
Yellow pine (Del., N. C., S. C., Ala., Fla., La., Tex., and trade)
Turpentine pine (N. C.)
Rosemary pine (N. C.)
Brown pine (Tenn.)
Hard pine (Ala., Miss., La.)
Georgia pine (general, Del.)
Fat pine (southern United States)
Southern yellow pine (general and trade)
Southern hard pine (general)
Southern heart pine (general)
Southern pitch pine (general)
Heart pine (N. C., and South Atlantic region)
Pitch pine (Atlantic region)
Longleaved yellow pine (Atlantic region and trade)
Longleaved pitch pine (Atlantic region)
Longstraw pine (Atlantic region)
North Carolina pitch pine (Va. and N. C.)
Georgia yellow pine (Atlantic region and trade)
Georgia heart pine (general)
Georgia longleaved pine (Atlantic region)
Georgia pitch pine (Atlantic region)
Florida yellow pine (Atlantic region)
Florida pine (Atlantic region)
Florida longleaved pine (Atlantic region)
Texas yellow pine (Atlantic region)
Texas longleaved pine (Atlantic region)
Florida longleaf yellow pine (trade)
Longleaf pine
Broom pine (lit.)

Loblolly Pine:

Loblolly pine (Del., Va., N. C., S. C., Ga., Ala., Fla., Miss., La., Tex., Ark.)
Oldfield pine (Del., Va., N. C., S. C., Ga., Ala., Fla., Miss., La., Tex., Ark.)
Torch pine (Eng. lit.)
Rosemary pine (Va., N. C., in part)
Slash pine (Va., N. C., in part)
Longschat pine (Del.)
Longshucks (Md., Va.)
Black slash pine (S. C.)
Frankincense pine (lit.)
Shortleaf pine (Va., N. C., S. C., La.)
Bull pine (Texas and Gulf region, Md., Ark.)

Virginia pine (trade)
Sap pine (Va., N. C.)
Virginia sap pine (eastern trade)
Meadow pine (Fla.)
Cornstalk pine (Va.)
Black pine (Va., N. C., Ga.)
Foxtail pine (Va., Md.)
Indian pine (Va., Md.)
Spruce pine (Va., in part)
Bastard pine (Va., N. C.)
Yellow pine (north Ala., N. C., Ark.)
Buckskin pine (La., Miss.)
Shortstraw pine
Swamp pine (Va., N. C.)
Longstraw pine (Va., N. C., in part)
North Carolina pine (trade)
Heart pine (N. C.)
Loblolly pine (Ga.)
Longleaf pine (Del., Md., Va., N. C.)
Maiden pine (N. C.)
Prop pine (Md., Va.)
Bog pine (N. C.)

Shortleaf Pine:

Yellow pine (N. Y., N. J., Pa., Del., Va., N. C., Ala., Miss., La., Ark., Mo., Ill., Ind.)
Shortleaf pine (Va., Md., Ga.)
Shortleaved pine (N. C., S. C., Ga., Ala., Miss., Fla., La., Tex., Ark.)
Spruce pine (Del., Miss., Ark.)
Bull pine (Va.)
Shortshat pine (Del.)
Pitch pine (Mo.)
Poor pine (Fla.)
Shortleaved yellow pine (trade)
Rosemary pine and rosemary shortleaf (N. C.)
Virginia yellow pine (Va., in part)
North Carolina yellow pine (N. C. and Va., in part)
North Carolina pine (N. C. and Va. in part; trade)
Carolina pine (N. C. and Va., in part)
Slash pine (N. C., Va., in part)
Oldfield pine (N. C., Ala., Miss.)
Forest pine (N. C.)
Southern yellow pine (trade)
Arkansas shortleaf pine (trade)
Arkansas soft pine (trade)
Rosemary pine (La., Tex.)

Virginia Pine:

Jersey pine (N. J., Pa., Del., N. C., S. C.)
Scrub pine (R. I., N. Y., Pa., Del., N. C., S. C., Ohio)
Short shucks (Md., Va.)
Shortshat pine (N. J., Md., Va., N. C., S. C., Tex., Ala.)
Shortleaved (N. C.)
Cedar pine (N. C.)
River pine (N. C.)
Nigger pine (Tenn., Ga.)
New Jersey pine (lit.)
Poverty pine
Black pine (Ga.)
Alligator pine (N. C.)
Hickory pine (N. C.)
North Carolina pine (N. C.)
Virginia pine (Md., Va., N. C.)
Spruce pine (Ga.)

Pond Pine:
Marsh pine (N. C.)
Meadow pine (N. C.)
Pond pine (N. C., S. C., Fla., Miss., La.)
Loblolly pine (N. C., Fla.)
Spruce pine (S. C., Ga.)
Bastard pine (S. C., Ga.)
Bull pine (S. C., Ga.)
Pocoson pine
Bay pine (N. C.)
Black-bark pine (N. C.)
Black pine (N. C.)

Spruce Pine:
Spruce pine (S. C., Ala., Fla.)
Cedar pine (Miss., La.)
White pine (S. C., Ga., Fla.)
Walter's pine (S. C.)
Lowland spruce pine (Fla.)
Poor pine (Fla.)
Kingstree (S. C.)
Black pine (Ala.)
Bottom white pine (Ga.)
Southern white pine (trade)

Slash Pine:
Slash pine (Miss., Ga., Fla.)
Swamp pine (Fla., Miss., Ala., in part)
Bastard pine (Ala., lumbermen, Fla.)
Meadow pine (Fla., eastern Miss., in part)
Pitch pine (Fla.)
She pitch pine (Ga.)
She pine (Ga., Fla.)
Spruce pine (southern Ala.)
Saltwater pine (Fla.)

Description

The southern pines belong to the yellow pine group—due primarily to the yellow cast of the wood and bark. They are true members of the coniferous or "softwood" family of trees. The wood is nonporous in structure and varies greatly, depending upon the species, rate of growth, site conditions, etc. The following nontechnical descriptions of the various pines herein discussed are intended for practical purposes only, in acquainting the consumer with outstanding properties and characteristics of these pines.

It should be remembered that the bulk of lumber cut from the various southern pines is usually classified under two groups—longleaf pine and shortleaf pine.

For information regarding the trade names of lumber, refer to Table 128. Also note the trade names of various species shown in these groups, inasmuch as many mills and producers specify these names with regard to lumber and allied products that they are cutting.

Longleaf Pine:

Sapwood is thin; generally light yellow to white; the heartwood varies from light red to orange. The wood is one of the heaviest of the southern pines. It is exceedingly hard for pine and is quite resinous. The wood is strong, tough, and very durable. Due to variations in the structure of the wood a pronounced figure is visible.

Loblolly Pine:

Due to fast growth the annual rings frequently are broad. The heartwood is pale yellow, very light in weight, fine texture, easily worked with the ring growth varying in width. It is not as resinous as longleaf pine and, because the heart content is not so great as in longleaf pine, it is not considered extremely durable. The trees of slower growth exhibit a smaller percentage of sapwood, resulting in greater durability. The increased density of the slow growth virgin trees makes a strong timber.

Shortleaf Pine:

Shortleaf or nondense southern pine lumber is suited, on account of its appearance and paint holding qualities, for all kinds of interior trim, especially where stained, painted, lacquered, hard-oiled, or varnished surfaces are desired. It is especially desirable for crating, is light in weight, holds nails well, and does not split easily. For insulation it is superior to dense lumber.

In general the wood of the shortleaf pine is strong, heavy, and hard, but it lacks the strength properties of longleaf pine.

The sapwood, while it varies—depending upon the growth—is nearly white in color. Heartwood varies from orange to orange brown, sometimes with a pink cast.

Virginia Pine:

Considered by many as one of the poorer of the southern pines, yet it is cut and consumed in rather large quantities. The wood structure varies.

The heartwood is light orange in color, with sapwood thick, usually white. It is moderately strong, but not very stiff. It is lighter than longleaf pine and lacks its strength qualities. Often the wood is brittle.

Pond Pine:

Compares quite favorably to longleaf pine and is about equal in strength. The wood is heavy, hard, and strong, but often brittle. Only a small amount is cut for lumber purposes.

Spruce Pine:

The wood closely resembles loblolly pine in structure. It is light and soft, and in certain sites closely resembles northern white pine. Its range is not extensive, and the cut is limited.

Slash Pine:

Slash pine is said to be the heaviest, hardest, and strongest of all the conifers in the United States. In structure it compares favorably with longleaf pine, with which the cut is often mixed. The wood is particularly dense and heavy. It is resinous and durable.

Uses

There is perhaps no other group of woods of which the species overlap which are as comparable to each other in structure and properties as the southern pines. Because of this similarity, as a general rule in the trade, more attention is given to density specifications than to species. Properties, density, and other factors control to a large degree the uses for these woods. Many fabricators and consumers, however, are familiar with a particular species—for example, longleaf pine, shortleaf Arkansas soft pine, etc.—and specify it in their purchases. This is done primarily because the specific properties of the wood are most advantageous for a certain use.

Density rules really should be the basis for the specific use of the southern pines, aside from damaging defects and other similar features. If great strength is required, a dense wood should be specified. This does not necessarily mean that longleaf pine would be required, inasmuch as virgin growth of shortleaf pine timber is often just as dense.

For other uses a lighter wood, *referred to as low density pine*—which in reality works more easily, splits less in handling, and retains paint, is required. Low density pine can be obtained from any of the various southern pines, regardless of species.

It is estimated that there are over one hundred and fifty important uses for southern pine. The southern pine group represents one of our most important structural wood species. In the matter of actual consumption it leads the list. It is extensively used for both interior and exterior construction—framing, siding, flooring, interior trim, sheathing, sash, doors, etc. Planing mill products consume perhaps three-quarters of the total cut.

Industrial fabrication for a multitude of uses requires large quantities. It has long been a popular wood for boxes and crates, containers, etc. Dense grades are usually used for heavy construction timbers, bridge timbers, piling, etc.

Classifications

Attention is called to the following grading rules for information regarding specifications, sizes, and grades for southern pine lumber:

Standard Specifications for Grades of Longleaf and Shortleaf Southern Pine Lumber—Southern Pine Association

Southern Yellow Pine Car Material Specifications—Southern Pine Association

Southern Yellow Pine—Bridge and Trestle Timbers for Railway Structures—Including Definition of New "Density" Rule—Southern Pine Association

Southern Yellow Pine Timbers—Including Definition of "Density" Rule—Southern Pine Association

The Gulf Coast Classification of Pitch Pine—Resawn Lumber and Sawn Timber—Southern Pine Association

Official Inspection Rules of the North Carolina Pine Association, Inc.

Grading Rules and Specifications for Arkansas Soft Pine—Arkansas Soft Pine Bureau

(See general list of Associations for addresses.)

Types and Sizes

(Refer to Tables 6, 7, 8, 15, 16, 18.)

Unit Packages

LUMBER: Sold on basis of 1,000 board feet

FINISH: Sold on basis of 1,000 board feet or lineal footage

FLOORING: Sold on basis of 1,000 board feet

Shipping Weights

The following tables give approximate shipping weights for southern pine lumber:

TABLE 129

NORTH CAROLINA PINE ASSOCIATION—WEIGHTS OF AIR-DRIED ROOFERS

Roofers ¾ x 5¼, 7¼, 9¼, 11¼ D2S and C M or D2S and S L	2200	Roofers ¾ x 3¾, 7¾, 9¾, 11¾, D4S	2300

WEIGHTS OF NORTH AND SOUTH CAROLINA PINE

Longleaf timbers, rough, green	4500	Shortleaf timbers, rough, green	4500
Longleaf timbers, dressed, green	3800	Shortleaf timbers, dressed, green	3800

ROUGH NORTH CAROLINA PINE, KILN-DRIED

4/4	3100	6/4	3500
5/4	3350	8/4	3500

TABLE 129—*Continued*

DRESSED NORTH CAROLINA PINE, MILL-RUN

Flooring, $\frac{25}{16}$, matched	2250	Case and molded base, all patterns	2000
Flooring, $\frac{25}{16}$, jointed	2500	Base, S4S, $\frac{25}{16}$	2500
Flooring, $1\frac{25}{16}$, matched	2250	Rails, S4S, 2 x 3 and 2 x 4	2700
Ceiling and partition, $\frac{25}{16}$	2250	Surfaced boards, 4 4	2500
Ceiling and partition, $\frac{5}{8}$	2000	Surfaced boards, 5 4	2700
Ceiling, $\frac{5}{8}$	1700	Surfaced boards, 6 4	2800
Ceiling, $\frac{1}{2}$	1250	Surfaced boards, 8 4	3000
Ceiling, $\frac{25}{32}$	1100	Box back strips, surfaced 1 or 2S	2500
Ceiling, $\frac{3}{8}$	1000	Factory flooring, $1\frac{25}{32}$, 2, $2\frac{25}{32}$ and 3 x 3 to 9 in.	2700
German siding, $\frac{5}{8}$ x $1\frac{1}{4}$ face	2000	Moldings, per inch per 100 ft.	20
Bevel siding, $\frac{1}{2}$ x 4 to 6	1200	Stair rails, per inch per 100 ft.	25
		Splines, standard, per M ft. lineal	200

TABLE 130

AVERAGE WEIGHTS OF SOUTHERN PINE WHEN WORKED TO STANDARD SIZE

	Lumber	*Shiplap*
Dry		
Flooring, $\frac{25}{32}$ x $2\frac{25}{32}$	2000	1800
Flooring, $\frac{25}{32}$ x $3\frac{1}{4}$	2100	1900
Flooring, $\frac{25}{32}$ x $4\frac{1}{2}$	2300	2100
Ceiling, $\frac{5}{16}$	1000	900
Ceiling, $\frac{3}{8}$	1200	1100
Ceiling, $\frac{1}{2}$	1500	1400
Ceiling, $\frac{25}{32}$	1800	1700
Partition, $\frac{1}{2}$	1900	1800
Siding, 6-in. rab. sash	1100	1000
Siding, 6-in. 1¼ rab. sash	1400	1250
Drop Siding, $\frac{1}{2}$	1900	
Drop Siding, $\frac{1}{2}$ and Molded Casing		1800
Molded Casing, $\frac{25}{32}$ x $4\frac{1}{2}$	2000	
Molded Base, 6-in. 10, 12 inch sash	2100	
Molded Base		2000
Finish, rab. S1S or S2S or $\frac{25}{32}$	2500	2400
Finish, $1\frac{1}{4}$, $1\frac{5}{8}$ and 2 rab. S1S or S2S		2700
or Standard Thickness	2800	
Finish, $1\frac{1}{4}$, $1\frac{5}{8}$ and 2 inch, rough	3400	3200
Industrial Standard 1 inch, S1S or S2S $\frac{25}{16}$"	2500	2500
Industrial Standard 1 inch, S1S or S2S $1\frac{25}{32}$"	3000	2900
Shipping Dry		
1 x 4, S2S and C. M. $\frac{25}{32}$	2300	2100
1 x 6, S2S and C. M. $\frac{25}{32}$	2400	
1 x 6, S1S and C. M. $\frac{25}{32}$		2200
Shiplap and D. & M. $\frac{25}{32}$	2600	2300
Grooved Roofing, $\frac{25}{32}$	2500	
Grooved Roofing		2300
Common Boards and Fencing, 1 x 4, 5, 6 and 10 in. S1S or S2S or $\frac{25}{32}$	2600	2400
Common Boards, 1 x 12, S1S or S2S or $\frac{25}{32}$	2700	2600
Industrial Standard Boards, 1-inch 4 to 12 inches $\frac{25}{16}$	2800	2600
Com. Boards and Fencing 1 x 4, 5, 6, or 10 inch, rough	3400	3300
Com. Boards, 1 x 12, rough	3500	3400
2 x 4, 2 x 6 and 2 x 8, S1S1E or $1\frac{25}{32}$	2700	2500
3 x 4, 3 x 6 and 3 x 8, rough	3400	3300
2 x 10 and 2 x 12, S1S1E or $1\frac{25}{32}$	2800	2600
3 x 10, 3 x 12, rough	3500	
Industrial Standard 2 x 4, 2 x 6, 3 x 6, S1E and 1E or S4S 1½	2900	
Industrial Standard 2 x 4, 2 x 6, 2 x 8, 1½		2700
Industrial Standard 2 x 10 and 2 x 12, S1E and 1E or S4S 1½	3000	
Industrial Standard, 3 x 10, 3 x 12, 1½		2800

Dry: For Hollow Back Flooring, Ceiling and Drop Siding, Deduct 200 Lbs.

TABLE 130—*Continued*

	Green	
2 x 14 and 3 x 12, S1S1E	3800	3500
2 x 14 and 3 x 12, rough	4500	4200
4 x 4 and 6 x 6, S1S1E	3800	....
4 x 4 and 6 x 6, rough	4500	....
3 x 4 and 6 x 6, S1S1E	....	3500
4 x 4 and 6 x 8, rough	....	4200
6 x 8 and over, rough	4500	....
6 x 8 and over, S4S	3800	....
8 x 8 and over, rough	....	4200
Plastering Lath, dry	550	500
Byrkit Lath, dry	1800	1650

Ordering

Specify Clearly:

Amount required
Grades
Thickness and width
If lumber is to be rough, surfaced (S1S, S2S, S4S, etc.), or further machined
Moisture content—type of seasoning (air-dried, kiln-dried, etc.)
Price (f. o. b. mill, plant, etc.)
Time or date needed (delivery to be made immediately, 30 days or 60 days)
Lumber manufactured in accordance with association grading rules conforming to American Lumber Standards
Grade marked lumber if practicable
If lumber is to be purchased on density rule basis

Caution

Watch for heavy or wet lumber.

See that grades, thicknesses, and proportionate amount of long lengths are contained in shipment (see Grading Rules).

Watch for split and damaged lumber due to poor loading.

Check footage contained in shipment.

Ascertain definitely if shipment meets in every respect the specifications shown on order.

If dense or structural material is ordered, see that it complies with specifications covering this material.

Special Service Requirements

Determine specifically whether the material ordered will efficiently answer the desired use, with particular reference to the following requirements:

Type of Use for which Material is Required: Building and construction (rough or finished, exterior or interior). Industrial fabrication (furniture, box and crate, etc.)

Type or Degree of Seasoning (see discussion on Seasoning): Air-dried (30, 60, 90 days or more on sticks, moisture content varies between 15 to 20 per cent). Kiln-dried (moisture content low; 6, 8 per cent)

Grades and Specifications (see Grading Rules Southern Yellow Pine for grade specified to cover desired use)

TYPES OF MACHINING: Surfacing required (S1S, S2S, S2S1E, S4S; required thickness and width after seasoning). Type and kind of machining (end-matched, shiplap, etc.)

Specifications

The following may be consulted for information on specifications:

Lumber—Simplified Practice Recommendation—Bureau of Standards.
Standards and Specifications in the Wood-Using Industries—Bureau of Standards.
National Directory of Commodity Specifications—Bureau of Standards.

(See general Bibliography for publishers' addresses.)

Engineering Data

(See Table 2.)

Improvements

To maintain constant definitions for moisture content, the Southern Pine Association has adopted moisture contents as follows:

Kiln-dried Lumber

C and Btr 4/4 and 5/4—The moisture content of this grade shall not exceed 12 per cent on 90 per cent of the shipment, and none of the remaining 10 per cent of the shipment shall exceed 15 per cent moisture content.

C and Btr 6/4 and 8/4—14 per cent on 90 per cent of the shipment; 17 per cent on 10 per cent of the shipment.

No. 1, No. 2, and No. 3 Com. boards and Strips—15 per cent on 90 per cent of shipment; 18 per cent on ten per cent of shipment.

No. 1 and No. 2 Dimension—15 per cent on 90 per cent of the shipment; 18 per cent on 10 per cent of shipment.

Air-dried:

The minimum and maximum figures shall be 4 per cent higher.

If as a result of an official claim inspection, it should be found that a certain proportion of the shipment exceeds these specified moisture limitations, such stock shall be dropped to the next lower grade.

St. Louis retailers were given the privilege of having all southern pine lumber received inspected by association inspectors, and to be grade marked after inspection. This action will place southern pine on a higher basis in all markets.

Associations

The following associations will be glad to give information regarding southern pines:

Southern Pine Association
Arkansas Soft Pine Bureau.
North Carolina Pine Association.
National Lumber Manufacturers Association.

(See general list of Associations for addresses.)

Publications

The following publications frequently carry trade items regarding southern pine, prices, etc.:

American Builder
American Lumberman
American Woodworking Review
Gulf Coast Lumberman
Lumber Co-Operator
Lumber Trade Journal
Millwork
Mississippi Valley Lumberman
National Lumberman
National Retail Lumber Dealer
New York Lumber Trade Journal, The
Retail Lumberman

Retail Lumber Trade News
Southern Lumberman
Veneers
Wood Workers Clearing House Journal
Wood Construction
Wood Preserving News
Wood-Worker, The
Wood Working Industries

(See general list of Periodicals for publishers' addresses.)

Bibliography

The following books and articles may prove useful to readers desiring further information:

Southern Pine Reference Book and Sales Manual—Southern Pine Association.
American Forest Trees—Henry H. Gibson.
Lumber and Its Uses—R. S. Kellogg.
The Use of Southern Yellow Pine in Car Construction—H. S. Sackett.
Longleaf Pine—Wilbur R. Mattoon.
Slash Pine—Wilbur R. Mattoon.
Shortleaf Pine Primer—Wilbur R. Mattoon.
Properties and Uses of the Southern Pines—H. S. Betts.
American Forests and Forest Products—Statistical Bulletin No. 21, Forest Service—U. S. Dept. of Agriculture.
Southern Yellow Pine—Forest Products Laboratory.
What is Meant by Hardwood and Softwood—Forest Products Laboratory.
Visual Method of Distinguishing Longleaf from Loblolly Pine and Shortleaf Pine—Forest Products Laboratory.

(See general Bibliography for publishers' addresses.)

Abbreviations and Terminology

Y. P.—yellow pine
S. Y. P.—southern yellow pine
S. P.—southern pine
L. L. P.—longleaf pine
Lob. P.—loblolly pine

(See general list of Abbreviations and Glossary.)

SUGAR PINE

(A Softwood)

Pinus lambertiana

Annual Production (1928).....305,940,000 bd. ft.
Average Value of Lumber Cut at Mill per M.B.F. (1928).....$39.06
Timber Stand (1920) (Estimated).....57,071,000,000 bd. ft.

Principal States Producing Cut—in Order of Importance (1928):

California, Oregon.

Range of Species

Coast region from Oregon to California; lower California.

Usual Name

Sugar pine

Also Called

California sugar pine
California soft pine (do not confuse with California white pine)

Description

Sugar pine is one of the outstanding species used in the lumber industry. Sugar pine, eastern white pine, and western white pine constitute the leaders in the "white pine" family. With the growing scarcity of eastern white pine, sugar pine is being used extensively and is rapidly taking the place of eastern white pine.

The sugar pine is primarily a native of California and southern Oregon, and from this region the commercial cut of this lumber is produced. In California it grows to large size and is considered one of the most valuable timber trees of the Pacific Coast, not only because of its natural high quality, but also because of its straightness of grain and freedom from defects. Sugar pine in its natural environment is found growing in rich, loose, sandy loam, and there reaches its best development.

The wood is usually light colored (creamy yellow to white), but the freshly sawed lumber darkens slightly upon exposure. It is light in weight and exceptionally straight-grained. It is easily worked, soft, and has a more pronounced odor than the other pines. Resin ducts are often quite conspicuous, and the wood is slightly coarser-textured than the other white pines.

It is classed as a durable wood, but not quite so durable as Idaho white pine.

Sugar pine dries easily and holds its shape well, is free from warp and twist, and is not subject to splitting.

Uses

Sugar pine has all the good qualities of eastern white pine and can be used for all purposes for which eastern white pine is used, particularly as building lumber. The sugar pine tree, being the largest pine in the world, produces a good percentage of wide, thick

Illustration 58—General range of sugar pine.

stock of high quality. The upper grades are now extensively used in the manufacture of doors, sash, and blinds, as well as for exterior and interior finish, siding, ceiling, molding, railway panels, newels, balusters, spindles, and furniture. The common grades are used for building purposes, boards, and dimension, and are also used extensively in the manufacture of box shooks.

Classifications

For detailed information regarding specifications, classifications, grading rules, etc., consult:

Standard Grading Rules for Pondosa Pine, California White Pine, Sugar Pine, Idaho White Pine, and Larch, Douglas Fir, White Fir, Spruce and Cedar Lumber —Western Pine Manufacturers Association, and California White and Sugar Pine Manufacturers Association, July 1, 1929.

(See general list of Associations for addresses.)

Types and Sizes

(See Tables 6, 7, 8, 15, 16, 18.)

General instructions covering reinspection, grade names, and broad divisions into grades conform to American Lumber Standards. The dressed sizes are also (with slight variations) minimum American Lumber Standards, or slightly thicker or wider than these standards. (See Tables 7 and 8.)

Unit Packages

Sugar pine yard and factory lumber is sold on board feet basis. Fabricated and machined stock measurements are based upon actual size prior to working. Molding and trim are frequently sold on lineal foot basis.

Shipping Weights

Shipping weights indicated below are approximate, but will be of value in arriving at general weights for various forms of lumber and fabricated stock:

TABLE 131

CALIFORNIA WHITE AND SUGAR PINE MANUFACTURERS ASSOCIATION—SHIPPING WEIGHTS FOR STATISTICAL PURPOSES—SUGAR PINE

Kind of Stock	*Net Thickness*	*Weight per 1,000 Bd. Ft.*
Rough	....	2,250 lbs.
S1S, S2S, or S4S	3/4	1,700 lbs.
4/4	25/32	1,750 lbs.
	13/16	1,850 lbs.
	7/8	1,950 lbs.
5/4	1 5/32	2,100 lbs.
6/4	1 13/32	2,100 lbs.
8/4	1 25/32	2,000 lbs.
	1 13/32	2,050 lbs.
Over 8/4	....	2,000 lbs.
Siding ½ Bevel	3/16 x 7/16	600 lbs.
Panel	½	1,100 lbs.

TABLE 132

COMPARATIVE SHIPPING WEIGHTS FOR SUGAR PINE FOR STATISTICAL PURPOSES

Kind of Stock	*Weight per 1,000 Bd. Ft.*
Finish	1,750 lbs.
Ceiling 3/8" finished to 9/16"	1,500 lbs.
Siding: Bevel	600 lbs.
Boards: Finished 25/32"	1,750 lbs.
Rough	2,250 lbs.

Ordering

(See general instructions on Ordering.)

Caution

(See general discussion.)

Special Service Requirements

Sugar pine, a soft white pine, is available in exceptionally large sizes, particularly in the upper grades.

It is preëminently a "finish" wood and is adaptable as an alternative wood for other "white" pine.

It is a specialty wood offering a wide range of uses, due primarily to its highly satisfactory physical and mechanical properties.

Low moisture content is required for interior finish and millwork products, or other specialty uses (pattern stock, industrial fabrication in furniture, etc.)

Specifications

The following publications may be consulted for information regarding specifications for sugar pine:

Lumber—Simplified Practice Recommendation—Bureau of Standards.
Standards and Specifications in the Wood-Using Industries—Bureau of Standards.
National Directory of Commodity Specifications—Bureau of Standards.

(See general Bibliography for publishers' addresses.)

Engineering Data

(See Table 2.)

Improvements

Sugar pine is now being used extensively for many purposes for which white pine was once used exclusively. Sugar pine manufacturers are making every effort to supply stock which will meet the requirements of white pine.

Particular efforts are being made to produce stock in accordance with standards, grades, moisture content, etc., and to effect efficient transportation to the consuming areas in the East.

Special attention is given to the production of stock as thick and wide as it is possible to manufacture. As previously mentioned this species is particularly notable for its extraordinarily large dimensions.

Associations

The following associations will be glad to give information regarding sugar pine lumber and material.

California White and Sugar Pine Manufacturers Association.
Millwork Institute of California.
Western Pine Manufacturers Association.

(See general list of Associations for addresses.)

Publications

The following publications frequently carry trade items regarding sugar pine stock, prices, and other data:

American Builder
American Lumberman
American Woodworking Review
Building Material Merchant
California Lumber Merchant
Crow's Pacific Coast Lumber Digest
Four L Lumber News
Lumber Co-Operator
Lumber Trade Journal
Millwork
Mississippi Valley Lumberman
National Lumberman
National Retail Lumber Dealer
New York Lumber Trade Journal, The

Retail Lumberman
Retail Lumber Trade News
Timberman, The
Veneers
West Coast Lumberman
Western Retail Lumberman
Western Wood Worker and Furniture Manufacturer
Weyerhæuser Log
Wood Workers Clearing House Journal
Wood Construction
Wood Preserving News
Wood-Worker, The
Wood Working Industries

(See general list of Periodicals for publishers' addresses.)

Bibliography

The following books and articles may prove useful to readers desiring further information:

Sugar Pine—L. T. Larsen and T. D. Woodbury.
Sugar Pine and Western Yellow Pine in California—Forest Service Bulletin No. 69.
"Sugar Pine and Western Hemlock"—E. J. Hanzlick—*Four L Lumber News*, Portland, Oregon, April 1, 1927.
Lumbering in the Sugar and Yellow Pine Region of California—Swift Berry.
American Forest Trees—Henry H. Gibson.

(See general Bibiliography and general list of Periodicals for publishers' addresses.)

Abbreviations and Terminology

S. P.—sugar pine
Cal. S. P.—California sugar pine
Calif. S. P.—California sugar pine

(See general list of Abbreviations and Glossary.)

REDWOOD[1]

(A Softwood)

Sequoia sempervirens

ANNUAL PRODUCTION (1928).....486,827,000 bd. ft.
AVERAGE VALUE OF LUMBER CUT AT MILL PER M. B. F. (1928).....$31.39
TIMBER STAND (1929).....67,500,000,000 bd. ft.

PRINCIPAL STATES PRODUCING CUT—IN ORDER OF IMPORTANCE (1928):

California.

Range of Species

From the southern borders of Oregon, southward in the coast region, through California.

Usual Name

Redwood (Sequoia sempervirens)

Also Called

Redwood (Calif. and Am. lit.)
Sequoia (Calif., Eng. trade)
Coast redwood (Calif.)
California redwood (Eng. lit., Am. trade)
Humboldt redwood (Calif. trade)

Description

The redwood of commerce is confined to a narrow strip in California, ranging from the southern border of Oregon (or Chetco River about six miles from its mouth, and on the Winchuck River), southward in the coast region twenty to thirty miles inland, through California (to Salmon Creek Canyon, twelve miles south of Punta Gorda, Monterey County).

It attains to its best growth in the fog belt along the Pacific slope of the coast range in northern California from and including Del Norte County to San Francisco Bay. Its botanical name (Sequoia sempervirens) means literally "live forever," and the tree represents one of the oldest living forms of tree growth existing today. The trees often reach an immense size, and grow straight and tall, with clean trunks, with a distance of from seventy-five to two hundred feet from the ground to the first branches. It is characteristic of the tree to require extreme moisture conditions, and it thrives best where it is nourished by the sea fog in the summer and rains in the winter.

[1] Another variety of redwood (Sequoia washingtoniana), noted for its size and age, is well known in this country and is also called "Big trees," Sequoia, giant Sequoia, or mammoth tree. Altogether there are approximately 25 groves, each containing from a few hundred to several thousand trees, confined to a small region in California (now National Parks). They are not now being cut for lumber purpose and rarely does this species enter the market.

In redwood the sapwood is confined to a very narrow band, white in color; the heartwood varies from a light pinkish-red to a reddish-brown.

It is very durable and ranks with other resistant woods, particularly the heartwood.

Illustration 59—General range of redwood.

The wood varies in quality and texture. However, it is generally straight-grained, light in weight, and works exceptionally well under tools. Redwood, although softer than the southern pines (longleaf, shortleaf, and loblolly), is harder than the white pines, ranking with Douglas fir in this respect, according to the Forest Products Laboratory, Madison, Wisconsin. The wood shrinks but little, holds its shape, contains no pitch, and checks very little during seasoning or when exposed to the sun.

Uses

Because of the resistance of the heartwood to decay, it is well adapted to the following uses:

Foundations, mud sills
Outside finish
Shingles
Posts and sleepers
Tunnel timbers
Silo staves
Fence posts
Railroad ties
Grape stakes
Greenhouse use
Tank stock
Pipe stock
Heavy mill construction
Highway and railroad bridges

In addition, due to its availability in clear, wide widths and long lengths, it is being used extensively in construction work for:

Beamed ceilings
Paneling
Wainscoting, etc.

Its properties make it particularly ideal for such important industrial uses as:

Sash, door, and blind work
Planing mill products (trim, siding, etc.)
General cut stock for factory flooring use
Novelty articles
candy boxes, cigar boxes, etc.
Veneers and plywood
Core-stock
Foundry flasks
Storage battery separators
Ice cream cabinets
Hog feeders, etc.

Classifications

For detailed information regarding specifications, grading rules, etc., consult:

Standard Specifications for Eastern Grades of California Redwood Lumber for Factory and Shop Lumber—California Redwood Association

Naturally Durable California Redwood in Structural Grades with Safe Working Stresses—California Redwood Association

(See general list of Associations for addresses.)

Types and Sizes

(See Tables 6, 7, 8, 15, 16, 18.)

Attention is also called to dressed sizes of California redwood lumber, as indicated in grading rules (*Standard Specifications for Eastern Grades of California Redwood Lumber*).

TABLE 133

Dressed Sizes

The thicknesses and widths of finished California Redwood Yard Lumber, SIS or S2S and/or S1E or S2E, D&M, or Shiplapped—except as indicated thus (*)—conform to the American Lumber Standards, and shall be as follows:

Finish, Common Boards and Strips, and Dimension

(The thicknesses apply to all widths and the widths to all thicknesses.)

Product	*Size, Board Measure*		*Dressed Sizes at Commercially Dry Shipping Weight and Moisture Content*		
	Thickness	*Width*	*Standard Thickness, Yard*	*Standard Thickness, Industrial*	*Standard Width*
	Inches	*Inches*	*Inches*	*Inches*	*Inches*
Finish, based on kiln-dried lumber	....	3	5/16	....	2 5/8
	....	4	7/16	....	3 1/2
	....	5	9/16	....	4 1/2
	....	6	11/16	....	5 1/2
	1	8	13/16*	13/16	7 1/2
	1 1/4	10	1 1/16	1 5/32*	9 1/2
	1 1/2	12	1 5/16	1 13/32*	11 1/2
	2	....	1 3/4	1 3/4	....
	2 1/2	....	2 1/8	....	....
	3	....	2 5/8	....	....
Common boards and strips	1	3	25/32	13/16	2 5/8
	1 1/4	4	1 1/16	....	3 5/8
	1 1/2	5	1 5/16	....	4 5/8
	....	6	....	....	5 5/8
	....	7	....	....	6 5/8
	....	8	....	....	7 1/2
	....	9	....	....	8 1/2
	....	10	....	....	9 1/2
	....	11	....	....	10 1/2
	....	12	....	....	11 1/2
Dimension	2	2	1 5/8	1 3/4	1 5/8
	2 1/2	4	2 1/8	....	3 5/8
	3	6	2 5/8	2 3/4*	5 5/8
	4	8	3 5/8	3 3/4*	7 1/2
	Over 4	10	Off 3/8	....	9 1/2
	....	12	....	....	11 1/2

TABLE 134

Siding, Flooring, Ceiling, Partition, Shiplap, and Dressed and Matched

(The thicknesses apply to all widths and the widths to all thicknesses.)

Product	*Size, Board Measure*		*Dressed Sizes at Commercially Dry Shipping Weight and Moisture Content*	
	Thickness	*Width*	*Standard Thickness*	*Standard Face Width*
	Inches	*Inches*	*Inches*	*Inches*
Bevel Siding (1/2")	....	4	15/32 x 3/16	3 1/2
	....	5	....	4 1/2
	....	6	....	5 1/2
	....	8	....	7 1/2
* Bungalow siding (5/8")	....	8	9/16 x 3/16	7 1/2
	....	10	....	9 1/2
* Bungalow siding (3/4")	....	8	11/16 x 1/4	7 1/2
	....	10	....	9 1/2
	....	12	....	11 1/2

TABLE 134—*Continued*

Product	Size, Board Measure		Dressed Sizes at Commercially Dry Shipping Weight and Moisture Content	
	Thickness	Width	Standard Thickness	Standard Face Width
	Inches	*Inches*	*Inches*	*Inches*
Rustic and drop siding (shiplapped)	....	4	9/16	3 1/8
	....	6	3/4	5 1/16
	....	8	....	6 7/8
Rustic and drop siding, D. & M	....	4	9/16	3 1/4
	....	6	3/4	5 3/16
	....	8	....	7
Flooring	....	2	5/16	1 1/2
	....	3	7/16	2 3/8
	....	4	9/16	3 1/4
	1	5	25/32	4 1/4
	1 1/4	6	1 1/16	5 3/16
	1 1/2	....	1 5/16	....
Ceiling	....	3	5/16	2 3/8
	....	4	7/16	3 1/4
	....	5	9/16	4 1/4
	....	6	11/16	5 3/16
Partition	....	3	3/4	2 3/8
	....	4	....	3 1/4
	....	5	....	4 1/4
	....	6	....	5 3/16
Shiplap	1	4	25/32	3 1/8
	....	6	....	5 1/8
	....	8	....	7 1/8
	....	10	....	9 1/8
	....	12	....	11 1/8
Dressed and Matched	1	4	25/32	3 1/4
	1 1/4	6	1 1/16	5 1/4
	1 1/2	8	1 5/16	7 1/4
	....	10	....	9 1/4
	....	12	....	11 1/4

Unit Packages

Redwood lumber is generally sold on board feet measure, based on actual measurements of piece, and is shipped air-dried (see grading rules for thicknesses, lengths, and widths for various grades).

Finish, common boards, strips, and dimension—uppers generally kiln-dried, sold on board feet basis, computed upon actual size of piece, based on rough lumber sizes.

Siding, flooring, ceiling, partition, shiplap, and dressed and matched—generally shipped kiln-dried, sold on board feet basis, computed upon actual size of piece prior to machining.

Molding, lattice—sold on lineal foot basis, kiln-dried.

Dimension, heavy joists, and small timbers—generally shipped air-dried or partly seasoned, sold on board feet basis.

Shingles (dimension and random width)—sold on bundle basis

Dimension: 5″—200 pieces to bundle

Dimension: 6″—150 pieces to bundle

Random width:

20″ wide, 25 course—4 bunches to M

Lath—sold on 1000-piece basis

(Bundle—500 lath to bundle)

Shipping Weights

TABLE 135

California Redwood Association—Dry Shipping Weights per M Feet

	Rough	*S2S*	*S4S*
Siding			*Lbs.*
Bevel			700
Bungalow Siding ½″			700
Bungalow Siding ⅝″			850
Bungalow Siding ¾″			1000
Shop and Pattern			
1″	2400	2100	....
1¼″ and 1½″	2500	2300	....
2″	2600	2300	....
2½″	2700	2500	....
3″	2800	2600	....
4″	3000	2800	....
Finish and Tank			
⅜″	1100	900	....
½″	1400	1100	....
⅝″	1700	1400	....
1″	2400	2000	1800
1¼″ and 1½″	2500	2200	2000
2″	2600	2300	2100
2½″	2700	2500	2300
3″	2800	2600	2400
4″	3000	2800	2600
5″	3200	2900	....
6″	3500	3100	....
8″	4000	3300	....
Drop Siding and Porch Flooring			
1″	1800	....	....
1¼″ and 1½″	2000	....	....
Ceiling			
⅜″	700	....	....
½″	850	....	....
⅝″	1100	....	....
1″	1600	....	....
1¼″ and 1½″	2000	....	....
Squares			
3″	2800	....	2000
4″	3000	....	2200
5″	3200	....	2400
6″	3500	....	2700
8″	3500	....	3000
10″	4000	....	3200
12″	4000	....	3500
Shingles			
16″ Rand. 5 to 2″ per 1000	....	200	....
16″ Rand. 5 to 1¾″ per 1000	....	180	....
5″ Dimension per bunch	....	45	....
6″ Dimension per bunch	....	40	....
Lath			
Per 1000	....	410	....

TABLE 135—*Continued*

Miscellaneous—Millwork and Moldings	*Lbs.*
Moldings	1400
Brick	1400
Lattice and grounds	1400
Barn battens	1400
Wallboard strips	1400
Gutter	1400
Balusters—turned	1400
Pickets	1600
Porch rail	1800
Round rail	1800
Poster molding	1800
Porch posts and newels	1800
Stave columns and newels	1800
Box columns and newels	1800
Balusters—square	1800
Frames	1800

Ordering

Specify amount desired: board feet, lineal feet, bundles, or pieces, depending upon commodity.

Specify commodity: rough lumber (yard lumber), finish, molding, millwork, etc.

Indicate whether material is to be worked or machined (indicate pattern, width, thickness, etc.)

If special, specify clearly what is desired.

Indicate desired moisture content: air-seasoned, give approximate moisture content; kiln-dried, approximate moisture content (i.e., dried to 7 to 10 per cent).

Caution

Specify clearly the shipping instructions (routings if necessary, indicating approximate delivery date).

In West Coast shipments water and rail shipments are economical. Generally kiln-dried stock is shipped by rail; rough lumber, heavy dimension, etc., by water.

In water shipments, moisture in lumber is often picked up.

Check incoming shipments (grades, amounts, etc.) and ascertain whether material comes up to specifications.

If commodities, inspect carefully for possible damage and degrade due to shifting loads, poor loading, etc. (This is purely a safety precaution.)

Special Service Requirements

In ordering special stock clearly indicate the use for which the stock is to be employed.

If special machining is necessary, detailed description of the pattern or working is required.

If short-length stock or odd-length stock, or nonstandard sizes or patterns are wanted, they should be specified.

Specify *heart* redwood for material which is to be used for exterior use, or under conditions favorable to decay.

In special stock certain fabrication can often be more economically done at the mill in conjunction with other machine work.

Specifications

The following publications may be consulted for information regarding specifications for redwood:

Lumber—Simplified Practice Recommendation—Bureau of Standards.
Standards and Specifications in the Wood-Using Industries—Bureau of Standards.
National Directory of Commodity Specifications—Bureau of Standards.

(See general Bibliography for publishers' addresses.)

Engineering Data

(See Table 2.)

Improvements

(See general discussion on Improvements.)

Associations

The following association will be glad to give information regarding lumber and other stock cut from redwood:

California Redwood Association.

(See general list of Associations for addresses.)

Publications

The following publications frequently carry trade items regarding redwood, prices, etc.:

American Builder
American Lumberman
American Woodworking Review
Building Material Merchant
California Lumber Merchant
Crow's Pacific Coast Lumber Digest
Four L Lumber News
Lumber Co-Operator
Lumber Trade Journal
Millwork
Mississippi Valley Lumberman
National Lumberman
National Retail Lumber Dealer
New York Lumber Trade Journal, The
Retail Lumberman
Retail Lumber Trade News
Timberman, The
Veneers
West Coast Lumberman
Western Retail Lumberman
Western Wood Worker and Furniture Manufacturer
Wood Workers Clearing House Journal
Wood Construction
Wood Preserving News
Wood-Worker, The
Wood Working Industries

(See general list of Periodicals for publishers' addresses.)

Bibliography

The following publications are available from the California Redwood Association:

Naturally-Durable California Redwood in Structural Grades.
Redwood Sales Manual.
California Redwood, Its Production and Uses.
Naturally Durable California Redwood in Modern Timber Structures.
California Redwood, Its Physical and Mechanical Properties in Comparison with Other Woods.
Standard Patterns of Worked Redwood Lumber.
Millwork Catalog.
Standard Molding Book.
The Pacific Lumber Company Redwood Advertising.
Construction Digest.
Engineering Digest.
Lumber Lists—Eastern.
Lumber Lists—Western.
Lumber Lists—Foreign.

The following books and articles may prove helpful to readers desiring further information.

Mechanical Properties of Redwood—A. L. Heim.
Uses of Commercial Woods of the United States—Cedars, Cypresses, and Sequoias—W. R. Hall and H. A. Maxwell.
Short Account of the Big Trees of California—U. S. Div. of Forestry.
Check List of Forest Trees of the United States, Their Names and Ranges—George B. Sudworth.
Lumber and Its Uses—R. S. Kellogg.
American Forest Trees—Henry H. Gibson.

(See general Bibliography for publishers' addresses.)

Abbreviations and Terminology

Redwood is seldom abbreviated in the trade.

(See general list of Abbreviations and Glossary.)

THE SPRUCES

(Softwoods)

RED SPRUCE
Picea rubra
(From northeastern states and Appalachian region)

WHITE SPRUCE
Picea glauca
(From Lake States, New York, and northern New England)

BLACK SPRUCE
Picea mariana
(Northeastern states)

ENGELMANN SPRUCE
Picea engelmannii
(Rocky Mountain region)

SITKA SPRUCE
Picea sitchensis
(Oregon and Washington)

ANNUAL PRODUCTION (1928)[1]—Total cut of all species.....571,917,000 bd. ft.

	Engelmann and Sitka Spruce	*Red, White, and Black Spruce*
AVERAGE VALUE OF LUMBER CUT AT MILL PER M. B. F. (1928)	$24.35	$29.12
TIMBER STAND (1920)	39,822,000,000 bd. ft.	31,572,000,000 bd. ft.
PRINCIPAL STATES PRODUCING CUT—IN ORDER OF IMPORTANCE (1928)	Washington, Oregon, California	West Virginia, Maine, Vermont, New Hampshire, North Carolina, Michigan

Range of Species

Red Spruce:

Prince Edward Island southward to the coast of Massachusetts, and through New England and New York, and northern Pennsylvania to North Carolina and Tennessee. Range imperfectly known.

White Spruce:

Labrador to Hudson Bay and northwestward through Alaska to Bering Strait; southward in the Atlantic region to Maine, New Hampshire, Vermont, northern New York, and in the Great Lakes region to Michigan, Wisconsin, and Minnesota.

Black Spruce:

Labrador to Mackenzie River, and northwestward into Alaska; southward through Newfoundland, eastern Canada, Michigan, Wisconsin, Minnesota, to central Pennsylvania, and in the mountains to northern Virginia.

[1] Production figures are not available for individual species of spruce, except as shown.

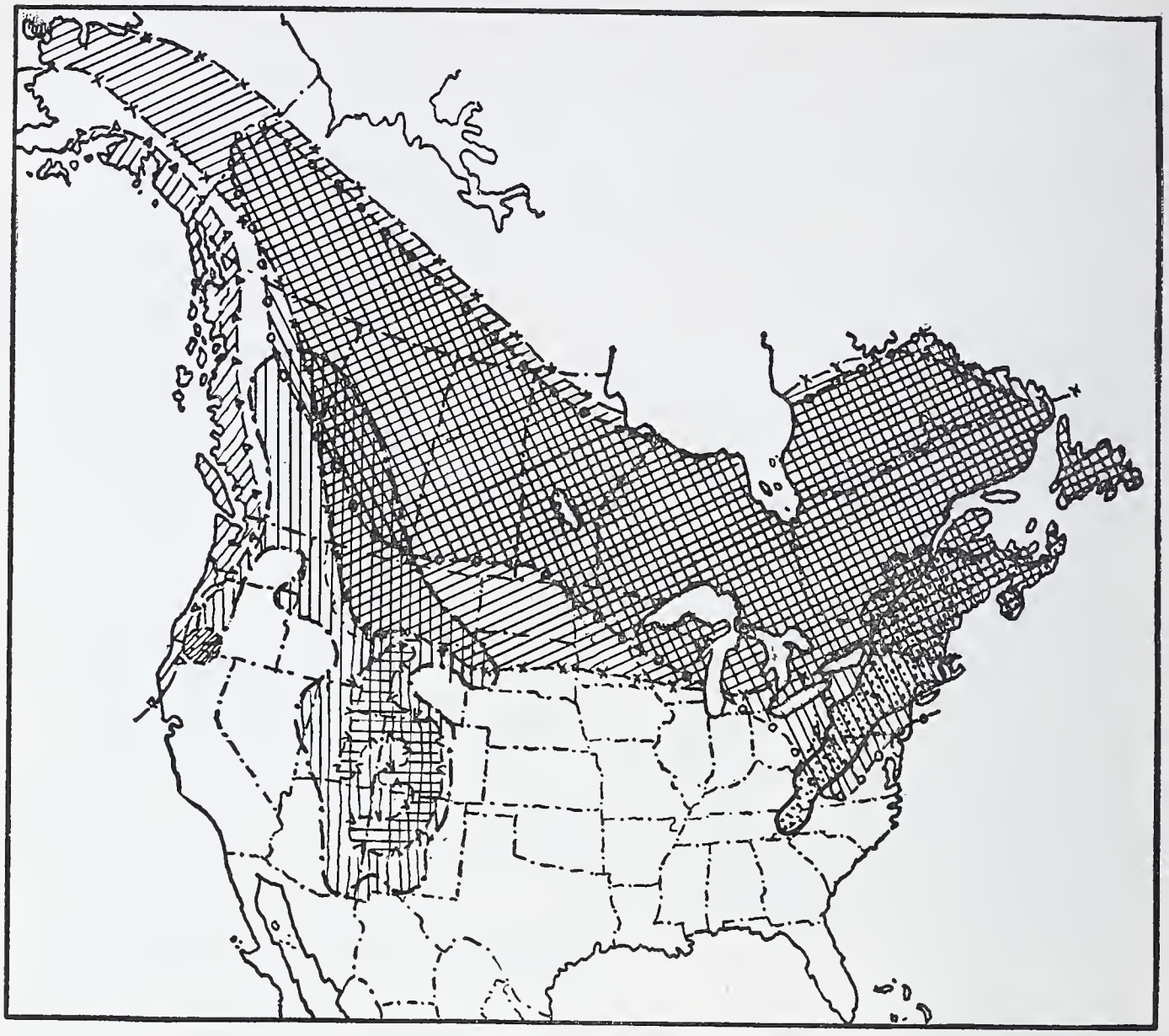


Illustration 60—General range of the spruces.

Engelmann Spruce:

From southeastern and northern Arizona and southern New Mexico, northward through the Rocky Mountain region to British Columbia, and westward to the eastern slopes of the Cascade Mountains in Oregon and Washington; occurs also in a small patch in the northeast corner of Shasta County, California, on the south fork of Clark Creek about eight miles northwest of Cayton Post Office.

Sitka Spruce:

Coast region from the east end of Kadiak Island and Alaska to northern California; in Washington as far inland as the Nisqually River.

Usual Names

Red spruce White spruce Black spruce	Sometimes referred to as eastern spruce
Engelmann spruce Sitka spruce	western spruce

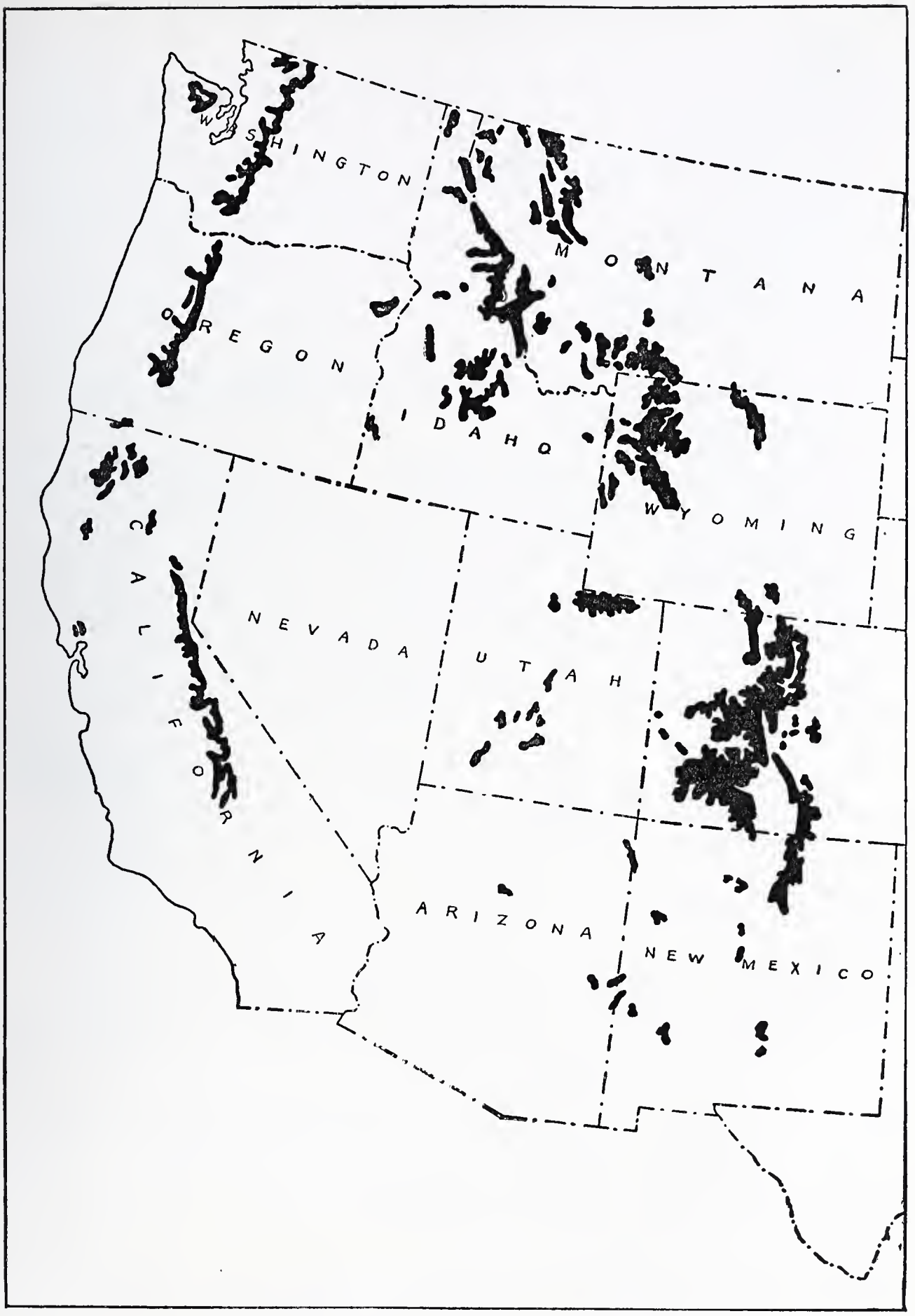


Illustration 61—General range of Sitka and Englemann spruces.

Also Called

Red Spruce:

Red spruce (trade)
Yellow spruce (N. Y.)
North American red spruce (foreign lit.)
Spruce (N. C.)
He balsam (N. C.)
West Virginia spruce (trade)
Canadian spruce (trade)
Adirondack spruce (trade)
Eastern spruce (trade, in part)

White Spruce:

White spruce (Vt., N. H., Mass., N. Y., Wis., Mich., Minn., Ontario, trade)
Single spruce (Me., Vt., Minn.)
Bog spruce (New Eng.)
Skunk spruce (Wis., Me., New Eng., Ontario)
Cat spruce (Me., New Eng.)
Spruce (Vt.)
Pine (Hudson Bay)
Double spruce (Vt.)
Blue spruce (Me.)
Eastern spruce (trade, in part)
Canadian spruce
Adirondack spruce (trade)

Black Spruce:

Black spruce (N. H., Vt., Mass., R. I., N. Y., Pa., W. Va., N. C., S. C., Wis., Mich., Minn., Ontario, New Eng., trade)
Double spruce (Me., Vt., Minn.)
Blue spruce (Wis.)
Spruce (Vt.)
White spruce (W. Va.)
Yew pine (W. Va.)
Juniper (N. C.)
Spruce pine (W. Va., Pa.)
He balsam (Me., N. C.)
Epinette Jaune (Quebec)
Water spruce (Canada and Maine)
Eastern spruce (trade, in part)

Engelmann Spruce:

Engelmann's spruce (Utah, Idaho)
Balsam (Utah)
White spruce (Canada, Ore., Colo., Utah, Idaho)
White pine (Utah, Idaho)
Mountain spruce (Mont.)
Arizona spruce (Calif., lit.)
Silver spruce (Colo.)

Sitka Spruce:

Tideland spruce (Calif., Ore., Wash.)
Menzies' spruce
Western spruce
Great Tideland spruce (Calif., lit.)
Sitka spruce (trade)
Alaska spruce (N. Y. and trade)
Yellow spruce (trade)
Western Sitka spruce (trade)
Silver spruce (trade)
Sequoia silver spruce (trade)
Spruce (trade)
West Coast spruce (trade)
Aeroplane spruce (trade)

Description

Red, White, and Black Spruce:

The red, white, and black spruces are generally grouped into one classification; namely eastern spruces. The wood of all of these species resembles each other greatly.

Red spruce is somewhat the lightest in weight, straighter-grained, and more even-textured than white or black spruce. White spruce is usually coarser-grained than the others. The heartwood is light, yellowish-brown, the sapwood white. Red spruce, weight for weight, is one of our strongest woods.

Black spruce and white spruce are quite similar in wood structure. The heartwood of the former is nearly white, with a slightly reddish tinge, while white spruce has a yellowish heartwood.

Engelmann Spruce:

The wood of Engelmann spruce is lighter than white pine and is the lightest of the species. The wood is not strong and has low elasticity. The wood, after weathering, is pale yellow tinged with red. In the trade little attention is given to the separation of the species in eastern markets, and Engelmann spruce is often included with shipments of Sitka spruce.

Sitka Spruce:

The wood varies in color, but is usually a very pale brown with a faint tinge of red. There is some variation in grain and texture, but on the whole the wood is light, strong, straight, and even-grained. It is slightly lighter in weight than white pine, but stronger. The wood seasons easily, with not much warp and twist.

Uses

Red, white, and black spruces are used in the East particularly for building material. They are for the most part not separated in the trade, but even when separated no distinction is made between the uses for black and white spruce. Red spruce is undoubtedly the most important of the three, and is used for dimension, scaffolding, ladder stock, and studding.

Spruce lumber of all varieties (low grade) is used to a large extent in the manufacture of boxes and crates. A large quantity goes into millwork, musical instruments, and specialty articles. Spruce is also much in demand for the manufacture of wood pulp.

Sitka spruce is an important source of lumber. Its production is increasing yearly, and by far leads in the production of spruce lumber. Its uses are greatly diversified. Certain of its properties make it ideal for millwork. Its most striking use is probably in airplane construction. The following are a few of its many uses:

Airplane construction
Veneer and plywood
House construction
Millwork
sash, doors, frames, porch and stair balusters
Poultry brooders
Sounding boards
Pipes for organs
Cornice brackets
Ladders
Store and office fronts
Decking and spars for boats
Wagon beds
Windmill slats, pattern stock
Boxes and crates
Cooperage, etc.
Food containers

Classifications

For detailed information regarding grading rules, specifications, etc., consult:

Eastern Spruces (Red, Black, and White):

Rules for the Grading of Northern Pine, Spruce, and Tamarack Lumber—Northern Pine Manufacturers Association

Engelmann Spruce:

Engelmann and Sitka spruce are graded under the same rules as Douglas Fir, by members of the Western Pine Manufacturers Association

Sitka Spruce (see "Engelmann Spruce," above):

Standard Grading and Dressing Rules for Douglas Fir, Sitka Spruce, West Coast Hemlock, and Western Red Cedar Lumber No. 9—Published by West Coast Lumbermen's Association

Spruce Grading Rules—Pacific Lumber Inspection Bureau

(See general list of Associations for addresses.)

Types and Sizes

For types and sizes of the varieties of spruce herein discussed, consult grading rules referred to above. (Also see Tables 6, 7, 8, 15, 16, 18.)

Unit Packages

Spruce lumber is generally sold on board feet measure. Surfaced and machined stock is sold on board feet measure basis, based upon actual measurements of the piece prior to working. Rough lumber is usually shipped air-dried. Finish and worked lumber is usually kiln-dried before shipment. Molding and molding trim is sold on lineal foot basis; is usually kiln-dried.

Shipping Weights

Shipping weights for items of eastern spruce are not available. (For general purposes refer to weights for northern white pine. See "Shipping Weights" for that species.)

TABLE 136

STANDARD SHIPPING WEIGHTS FOR ENGELMANN SPRUCE AND SITKA SPRUCE

West Coast Lumbermen's Association.

Kind of Stock	*Weight per 1,000 Bd. Ft.*
Base	2,000 lbs.
Casing	1,800 lbs.
Bevel siding	800 lbs.
Bungalow siding	1,100 lbs.
Finish, ½", S2S, or S4S	1,500 lbs.
1"	2,000 lbs.
1¼", 1½", S2S or S4S	2,500 lbs.
Rough dry, 1"	2,600 lbs.
Rough dry, 1¼" to 2"	2,900 lbs.
Rough green	3,500 lbs.
Lath	500 lbs.
Shop, 1", S2S	2,000 lbs.
1¼", 1½", and 2", S2S	2,500 lbs.
2½" and 3", S2S	2,800 lbs.
Rough dry 1"	2,600 lbs.
Rough dry 1¼", 1½", and 2"	2,900 lbs.
Rough dry 2¼" and 3"	3,000 lbs.

Ordering

(Follow general instructions under "Ordering.")

Caution

(Follow general instructions under "Caution.")

Special Service Requirements

The light weight and great strength of the spruces make them particularly valuable where these properties must be considered.

The eastern spruces are often substituted for northern white pine.

Spruces also afford unexcelled properties where a musical tone for sounding boards is required.

Sitka spruce is available in large sizes.

Spruce likewise does not impart odor or taste, and is used extensively for cooperage purposes.

Specifications

The following may be consulted for information on specifications:

Lumber—Simplified Practice Recommendation—Bureau of Standards.

Standards and Specifications in the Wood-Using Industries—Bureau of Standards.

National Directory of Commodity Specifications—Bureau of Standards.

(See general Bibliography for publishers' addresses.)

Engineering Data

(See Table 2.)

Improvements

(See general discussion under this heading.)

Associations

The following associations will be glad to give information regarding lumber and other stock cut from the spruces:

EASTERN SPRUCES:
Northern Pine Manufacturers Association.

ENGELMANN AND SITKA SPRUCE:
West Coast Lumbermen's Association.

ENGELMANN SPRUCE:
Western Pine Manufacturers Association.

(See general list of Associations for addresses.)

Publications

The following publications frequently carry trade items regarding prices, etc., of the eastern spruces, and Engelmann and Sitka spruce:

EASTERN SPRUCE:

American Lumberman
American Woodworking Review
Lumber Co-Operator
Lumber Trade Journal
Millwork
Mississippi Valley Lumberman
National Lumberman
National Retail Lumber Dealer
New York Lumber Trade Journal, The
Retail Lumberman
Retail Lumber Trade News
Southern Lumberman
Wood Workers Clearing House Journal

WESTERN SPRUCES:

American Lumberman
Building Material Merchant
California Lumber Merchant
Crow's Pacific Lumber Digest
Four L Lumber News
Lumber Co-Operator
Lumber Trade Journal
Millwork
New York Lumber Trade Journal, The
Retail Lumberman
Timberman, The
Veneers
West Coast Lumberman
Western Retail Lumberman
Western Wood Worker and Furniture Manufacturer
Wood Construction
Wood-Worker, The
Wood Working Industries

(See general list of Periodicals for publishers' addresses.)

Bibliography

The following books and articles may prove useful to readers desiring further information:

The Red Spruce—G. B. SUDWORTH.
The Spruce and Balsam Fir in the Rocky Mountains—G. B. SUDWORTH.
Sitka Spruce—Its Uses, Growth, and Management—N. L. CARY.
Check List of Forest Trees of the United States, Their Names and Ranges—G. B. SUDWORTH.
American Forest Trees—HENRY H. GIBSON.
West Coast Woods, Douglas Fir, West Coast Hemlock, Western Red Cedar, and Sitka Spruce—West Coast Lumbermen's Association.
Sitka Spruce—West Coast Lumbermen's Association.

(See general Bibliography for publishers' addresses.)

Abbreviations and Terminology

(See list of Abbreviations and Glossary.)

TAMARACK

(A Softwood)

Larix laricina

ANNUAL PRODUCTION (1928).....10,827,000 bd. ft.
AVERAGE VALUE OF LUMBER CUT AT MILL PER M. B. F. (1928).....$25.35
TIMBER STAND.....(Not available)

PRINCIPAL STATES PRODUCING CUT—IN ORDER OF IMPORTANCE (1928):

Wisconsin, Minnesota, Michigan, Maine.

Range of Species

From Newfoundland and Labrador northward through the Hudson Bay Region, to the Mackenzie River, and reappearing in Alaska between Cook Inlet and the Yukon River; southward in the East to northern and eastern Pennsylvania; western Maryland, West Virginia, northern Ohio, Indiana, and Illinois, and northeastern Minnesota; in western Canada extending southward along the eastern base of the Rockies.

In the East the tamarack naturally prefers a wet or swampy situation, although there are exceptions, for in the North its distribution is more varied.

Usual Name

Tamarack

Also Called

Larch (Vt., Mass., R. I., Conn., N. Y., N. J., Pa., Del., Wis., Minn., Ohio., Ontario)
Tamarack (Me., N. H., Vt., Mass., R. I., N. Y., N. J., Pa., Ind., Ill., Wis., Mich., Minn., Ohio, Ontario)
Hackmatack (Me., N. H., Mass., R. I., Del., Ill., Minn., Ontario)
American larch (Vt., Wis., nurserymen)
Juniper (Me., New Brunswick to Hudson Bay)
Black larch (Minn.)
Epinette rouge (Quebec)
Ka-neh-tens "The Leaves Fall" (Indians, N. Y.)
Red larch (Mich.)
Hacmack (lit.)

Description

The wood of eastern tamarack is heavy, hard, very strong, and stiff, and is durable in contact with the soil. Unfortunately, rather extreme variations in the strength of the wood itself are often encountered. The wood is somewhat coarse-grained and brittle; it is inclined to warp when drying. In both species this difficulty has been experienced. The heartwood is light brown with narrow band of sapwood nearly white.

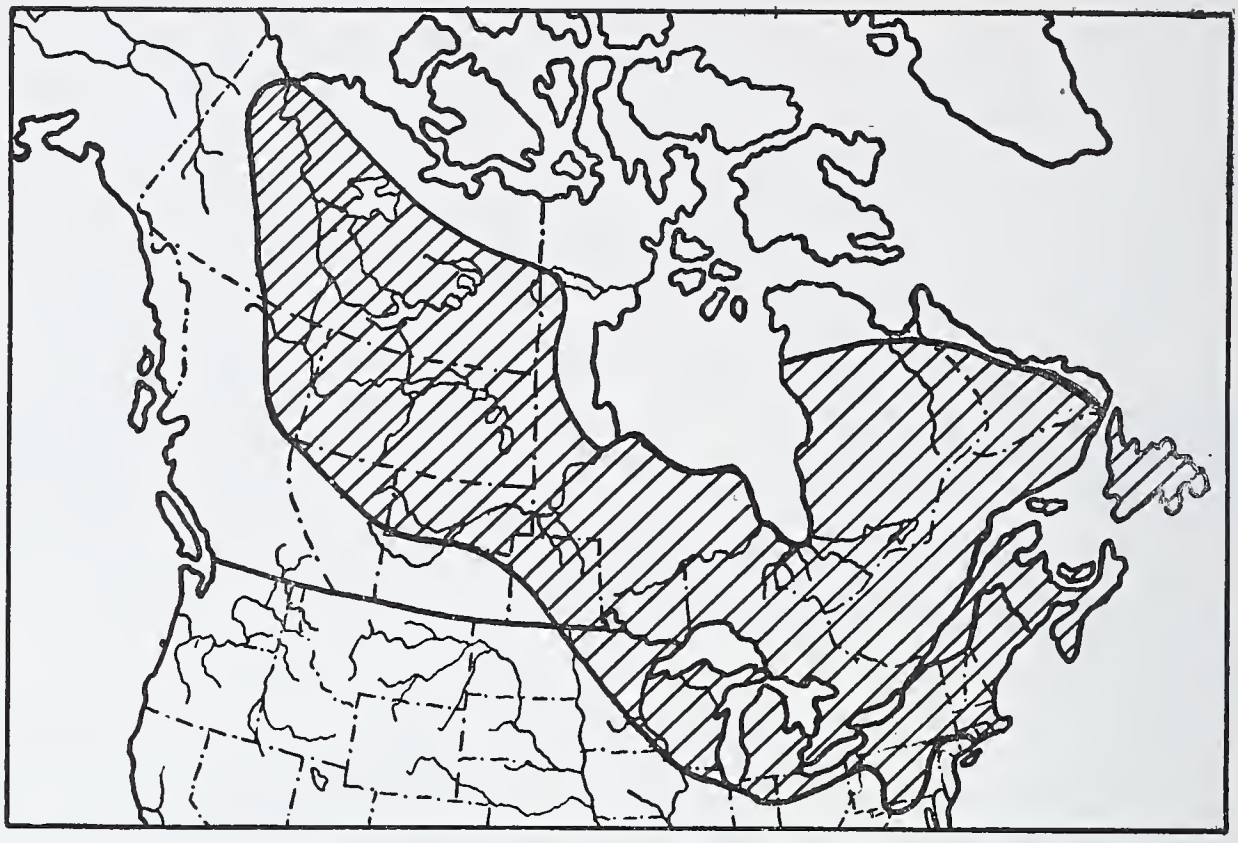


Illustration 62—General range of eastern tamarack.

Uses

Tamarack is used principally for secondary construction purposes, posts, poles and rough construction timber, and dimension. Some quantities are now being used in the box and crate industry, for excelsior, pails and buckets, wooden pipe, and in the past it was used in the boat industry.

Classifications

Detailed information on specifications, grading rules, etc., may be found in:

Official Grading Rules for Hemlock and Tamarack—Northern Hemlock and Hardwood Manufacturers Association.

Rules for the Grading of Northern Pine, Spruce, and Tamarack Lumber—Northern Pine Manufacturers Association.

(See general list of Associations for addresses.)

Types and Sizes

(See Tables 6, 7, 8, 16, 18.)

Eastern Tamarack:

Sizes and grades are the same as for eastern hemlock.

Unit Packages

Lumber is sold on board feet basis, and in accordance with American Lumber Standards.

Stock that is bundled is tied separately, according to length. Finished stock, stock cut to pattern, or surfaced lumber is sold on board feet measure. Retail yards frequently sell on lineal foot basis. Board measure is based upon stock necessarily used in its manufacture.

Shipping Weights

Weights of tamarack are not available but compare favorably with eastern hemlock.

Ordering

General ordering instructions are similar to those for eastern hemlock. Local conditions and regional availability will decide in most instances which species of Larix to specify.

Caution

Up to 10 per cent of tamarack is admitted in the common grades of hemlock, except in finish, ceiling, flooring, partition, and siding, unless otherwise specified at the time of selling, but no tamarack lath may be admitted in hemlock lath.

The actual thickness and width of lumber shipped, when not of standard or extra size, shall be indicated on the invoice.

In the grading rules the term "Extra Standard" refers to Industrial Standard as decided under American Lumber Standard definitions. Extra Standard or Industrial Standard lumber is thicker than ordinary standard yard lumber.

Special Service Requirements

It is well to keep in mind that these species can be substituted in many cases for woods similar in character. For rough construction purposes they are ideally suited. Likewise, they have an important use in the box and crate industry.

Specifications

The following publications may be consulted for information regarding specifications for tamarack:

Lumber—Simplified Practice Recommendation—Bureau of Standards.
Standards and Specifications in the Wood-Using Industries—Bureau of Standards.
National Directory of Commodity Specifications—Bureau of Standards.

(See general Bibliography for publishers' addresses.)

Engineering Data

(See Table 2.)

Improvements

(See general discussion under this heading.)

Associations

The following associations will be glad to give information regarding lumber and other stock cut from tamarack:

Northern Pine Manufacturers Association.

Northern Hemlock and Hardwood Manufacturers Association.

(See general list of Associations for addresses.)

Publications

The following publications frequently carry trade items regarding tamarack:

American Builder
American Lumberman
American Woodworking Review
Gulf Coast Lumberman
Lumber Co-Operator
Lumber Trade Journal
Millwork
Mississippi Valley Lumberman
National Lumberman
National Retail Lumber Dealer
New York Lumber Trade Journal, The
Retail Lumberman
Retail Lumber Trade News
Southern Lumberman
Veneers
Wood Workers Clearing House Journal
Wood Construction
Wood Preserving News
Wood-Worker, The
Wood Working Industries

(See general list of Periodicals for publishers' addresses.)

Bibliography

The following books and articles may prove useful to readers requiring further information:

"The Commercial Importance of Tamarack"—A. H. D. Ross—*Canadian Lumberman and Woodworker*, Aug. 1, 1915.

Guidebook for the Identification of Woods Used for Ties and Timbers—Arthur Koehler.

Handbook of Trees in the Northern States and Canada, East of the Rocky Mountains—R. B. Hough.

Lumber and Its Uses—R. S. Kellogg.

American Forest Trees—Henry H. Gibson.

(See general Bibliography for publishers' addresses.)

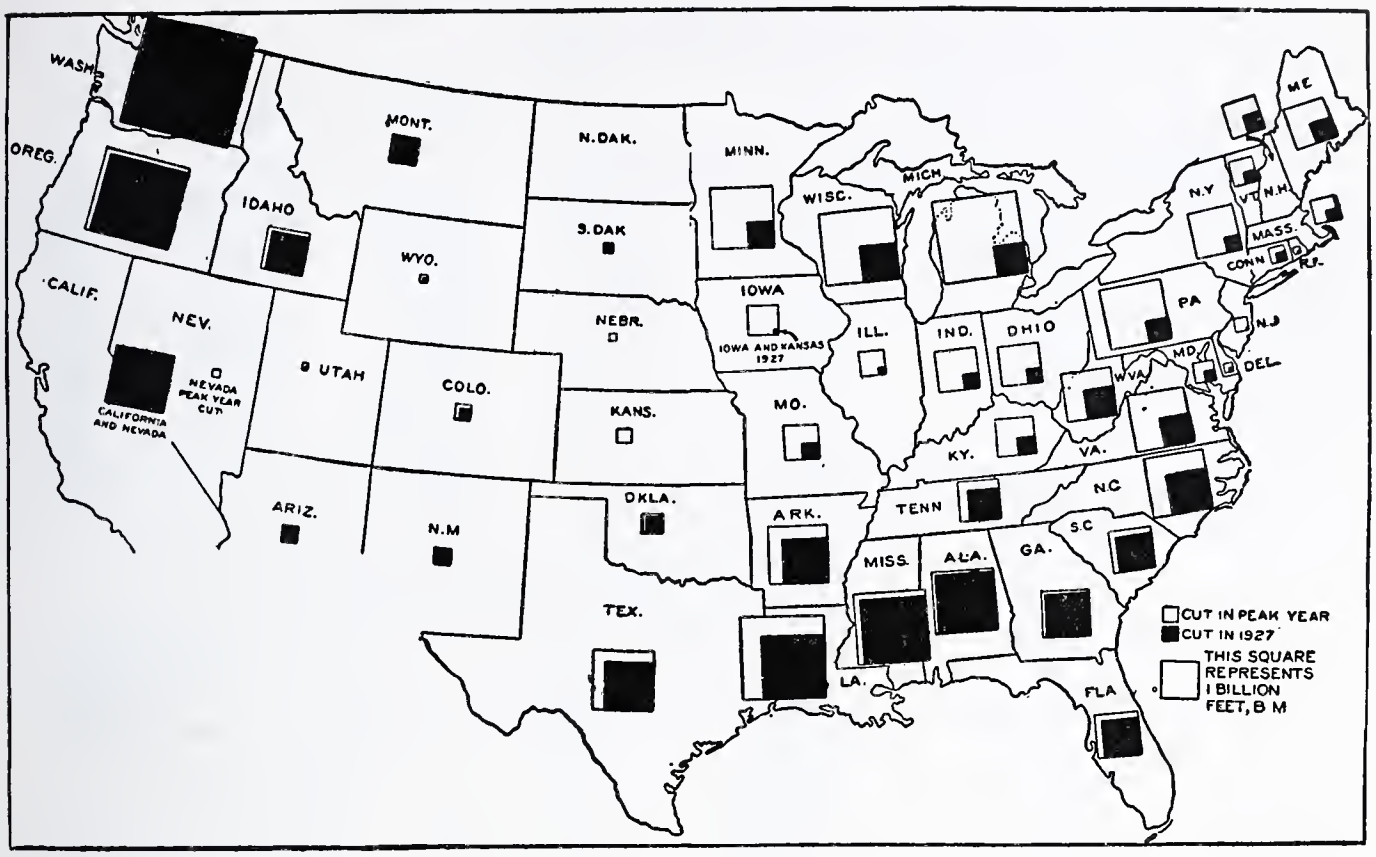
Abbreviations and Terminology

Tamarack is seldom abbreviated.

(See general list of Abbreviations and Glossary.)

TABLE 137

LUMBER PRODUCTION, RELATIVE SIZE OF CUT BY STATES, 1927 AND RELATIVE SIZE OF CUT IN PEAK YEAR OF STATE: 1839–1927[1]



PERCENTAGE OF SOFTWOODS AND HARDWOODS 1927

State	Softwoods, Per cent	Hardwoods, Per cent	Mills Reporting, Number	State	Softwoods, Per cent	Hardwoods, Per cent	Mills Reporting, Number
Alabama	87	13	1,647	New Hampshire	88	12	252
Arizona	100	...	26	New Jersey	5	95	24
Arkansas	60	40	460	New Mexico	100	...	73
California-Nevada	100	(2)	160	New York	27	73	399
Colorado	100	(2)	116	North Carolina	78	22	1,144
Connecticut	34	66	144	North Dakota	...	...	...
Delaware	78	22	45	Ohio	(2)	100	379
Florida	97	3	183	Oklahoma	91	9	74
Georgia	86	14	1,134	Oregon	100	(2)	379
Idaho	100	(2)	146	Pennsylvania	32	68	589
Illinois	3	97	50	Rhode Island	35	65	16
Indiana	(2)	100	256	South Carolina	78	22	370
Iowa and Kansas	...	100	26	South Dakota	100	...	48
Kentucky	8	92	375	Tennessee	16	84	567
Louisiana	70	30	237	Texas	84	16	194
Maine	88	12	407	Utah	97	3	49
Maryland	47	53	256	Vermont	53	47	253
Massachusetts	68	32	175	Virginia	60	40	688
Michigan	24	76	143	Washington	100	(2)	472
Minnesota	94	6	131	West Virginia	20	80	223
Mississippi	32	18	837	Wisconsin	40	60	198
Missouri	24	76	356	Wyoming	100	...	39
Montana	100	(2)	126				
Nebraska	...	...	...	United States	82	18	13,866

[1] The principal Lumber Industries—Lumber and Timber Products, Planing Mill Products, Boxes, Wooden Cooperage; Census of Manufactures: 1927; Bureau of the Census, Department of Commerce, Washington, D. C. (Compiled in coöperation with The United States Department of Agriculture, Forest Service.)

[2] Less than five-tenths of 1 per cent.

TABLE 138

1928 Consumption of Lumber by Leading Industries [1]

(By Rank of Importance)

(All figures in this table are in units of one thousand board feet.)

Name of Industry	*Foreign Woods*	*Domestic Woods*		*Total*
		Hardwoods	*Softwoods*	
Planing mill products	1,085	957,629	4,104,669	5,063,583
Boxes and crates	92	1,144,875	3,671,733	4,816,700
Sash, doors, blinds and general millwork	15,901	515,527	2,785,918	3,317,346
Furniture	45,131	1,093,278	60,203	1,198,612
Car construction and repair	1,691	160,983	846,734	1,009,408
Motor vehicles	944	757,673	109,258	867,875
Baskets and fruit packages	....	153,909	107,621	261,530
Chair and chair stock	2,362	161,022	2,008	165,392
Caskets and coffins	1,533	60,780	93,795	156,108
Refrigerators and kitchen cabinets	11	79,742	65,992	145,745

[1] Lumber Used in Manufacture, 1928, compiled by the Forest Service in coöperation with the Bureau of Census U. S. Dept. of Commerce.

TABLE 139

Lumber—Production, by Principal Kinds of Wood: 1928 and 1927

Kind of Wood	1928		1927	
	Quantity [1] *M Feet b.m.*	*Per Cent Distribution*	*Quantity* [1] *M Feet b.m.*	*Per Cent Distribution*
Total	34,142,123	100.0	34,532,420	100.0
Ash	130,099	0.4	136,820	0.4
Balsam fir	19,066	(2)	15,939	(2)
Basswood	140,094	.4	145,601	.4
Beech	146,207	.5	154,158	.4
Birch	337,550	1.0	326,788	.9
Cedar	266,877	.8	305,964	.9
Chestnut	259,769	.8	263,771	.8
Cottonwood	143,562	.4	103,535	.3
Cypress	501,422	1.5	609,679	1.8
Douglas fir	8,449,282	24.8	8,443,053	24.5
Elm	155,903	.5	160,536	.5
Hemlock	2,221,756	6.5	2,070,812	6.0
Hickory	47,786	.1	51,584	.1
Larch	250,518	.7	288,327	.8
Lodgepole pine	26,537	.1	13,255	(2)
Maple	742,642	2.2	774,000	2.2
Oak	1,830,260	5.4	2,013,053	5.8
Red gum	967,756	2.5	1,101,112	3.2
Redwood	486,827	1.4	569,605	1.6
Spruce	571,917	1.7	529,467	1.5
Sugar pine	305,940	.9	282,217	.8
Sycamore	38,454	.1	29,487	.1
Tupelo	316,554	.9	267,192	.8
Walnut	56,650	.2	65,081	.2
Western yellow pine	2,975,748	8.7	2,798,754	8.1
White fir [3]	292,085	.9	279,737	.8
White pine	1,366,933	4.0	1,344,466	3.9
Yellow pine	10,610,290	31.1	10,891,247	31.5
Yellow poplar	327,833	1.0	334,604	1.0
Other	155,806	.5	162,576	.5

[1] Not including production of mills cutting less than 50,000 feet.

[2] Less than one-tenth of one per cent.

[3] Includes all western firs except Douglas fir.

TABLE 140

LUMBER—PRODUCTION, BY STATES: 1928 AND 1927

State	Number of Mills		Lumber Cut (M Feet b. m.)[1]		
	1928	1927	1928	1927	Per Cent of Increase (+) or Decrease (−)
United States	13,268	13,756	34,142,123	34,532,420	− 1.1
Alabama	1,502	1,647	1,980,082	2,171,687	− 8.8
Arizona	25	26	158,047	169,085	− 6.5
Arkansas	423	460	1,129,731	1,229,481	− 8.1
California and Nevada [2]	165	154	1,952,659	2,070,811	− 5.7
Colorado	140	116	72,257	67,321	+ 7.3
Connecticut	139	144	35,356	55,949	− 36.8
Delaware	35	45	13,161	16,824	− 21.8
Florida	203	183	995,072	907,128	+ 9.7
Georgia	982	1,133	1,039,475	1,201,008	− 13.4
Idaho	144	145	977,468	923,986	+ 5.8
Illinois	52	50	29,623	28,663	+ 3.3
Indiana	219	256	126,790	148,492	− 14.6
Iowa and Kansas [2]	25	27	13,908	16,982	− 18.1
Kentucky	331	375	174,340	197,618	− 11.8
Louisiana	226	237	2,278,422	2,385,724	− 4.5
Maine	411	400	266,523	263,818	+ 1.0
Maryland	226	256	59,729	67,541	− 11.6
Massachusetts	169	175	112,299	88,298	+ 27.2
Michigan	141	143	572,059	578,254	− 1.1
Minnesota	136	123	412,343	396,891	+ 3.9
Mississippi	825	837	2,524,319	2,556,612	− 1.3
Missouri	346	356	141,990	189,136	− 24.9
Montana	119	126	387,879	396,267	− 2.1
New Hampshire	279	252	239,261	215,912	+ 10.8
New Jersey	22	24	3,220	5,044	− 36.2
New Mexico	77	73	162,030	172,517	− 6.1
New York	364	399	130,106	142,505	− 8.7
North Carolina	1,105	1,142	1,020,893	1,055,222	− 3.3
Ohio	332	379	112,229	127,880	− 12.2
Oklahoma	96	74	193,793	169,943	+ 14.0
Oregon	440	369	4,371,924	3,992,852	+ 9.5
Pennsylvania	506	589	238,615	277,722	− 14.1
Rhode Island	15	16	4,622	6,815	− 32.2
South Carolina	372	370	821,900	817,016	+ 0.6
South Dakota	52	48	53,967	46,909	+ 15.0
Tennessee	505	566	530,306	595,297	− 10.9
Texas	215	194	1,446,686	1,446,460	+ 0.1
Utah	59	49	7,623	6,152	+ 23.9
Vermont	244	252	107,358	90,880	+ 18.1
Virginia	703	688	547,706	535,616	+ 2.3
Washington	433	400	7,305,277	7,325,862	− 0.3
West Virginia	225	223	547,823	541,870	+ 1.1
Wisconsin	191	197	818,850	819,507	− 0.1
Wyoming	49	38	24,402	12,863	+ 89.7

[1] Not including production of mills cutting less than 50,000 feet.
[2] Combined to avoid disclosing production of individual establishments.

TABLE 141

AVERAGE VALUES OF LUMBER AT THE MILL PER M FEET, BOARD MEASURE, BY KINDS OF WOOD, FOR SPECIFIED YEARS: 1899 TO 1927 [1]

Kind of Wood	*1927*	*1926*	*1925*	*1924*	*1923*	*1922*	*1921*	*1919*	*1917*	*1915*	*1911*	*1909*	*1904*	*1899*
All kinds [2]	$25.80	$27.34	$28.02	$28.57	$31.78	$26.15	$23.47	$30.21	$20.32	$14.04	$15.05	$15.38	$12.76	$11.13
SOFTWOODS														
Balsam fir	25.92	25.64	26.65	27.66	27.62	25.05	25.71	32.23	20.02	13.79	13.42	13.99	(3)	(3)
Cedar	34.39	37.28	38.80	38.74	37.56	29.19	38.55	33.80	19.40	16.10	13.36	19.95	14.35	10.91
Cypress	39.91	43.33	40.90	42.08	44.61	40.05	36.88	38.38	23.92	19.85	20.54	20.46	17.50	13.32
Douglas fir	19.45	20.17	20.94	22.08	26.99	20.93	18.04	24.62	16.28	10.59	11.05	12.44	9.51	8.67
Hemlock	19.06	20.23	21.58	23.35	26.21	21.83	20.79	29.16	20.78	13.14	13.59	13.95	11.91	9.98
Larch (tamarack)	17.69	17.77	18.25	20.82	21.98	18.54	15.56	23.39	16.21	10.78	11.87	12.68	11.39	8.73
Lodgepole pine	20.82	19.98	20.22	21.07	21.76	19.07	21.81	29.98	18.34	13.57	12.41	16.25	(3)	(3)
Redwood	33.81	33.80	33.99	35.90	43.08	35.72	40.57	30.04	21.00	13.54	13.99	14.80	12.83	10.12
Spruce	26.59	27.27	27.98	30.18	31.44	25.47	25.73	30.76	24.41	16.58	16.14	16.91	14.03	11.27
Sugar pine	43.22	48.45	44.79	40.54	45.33	43.78	37.83	35.99	24.69	17.40	17.52	18.14	(3)	12.30
Western yellow pine	26.04	26.63	27.70	27.73	33.09	27.75	26.95	27.75	19.59	14.32	13.62	15.39	11.30	9.70
White fir	19.92	20.15	22.51	21.69	23.84	19.97	21.37	25.66	17.16	10.94	10.64	13.10	(3)	(3)
White pine	29.90	31.36	32.58	32.66	34.85	36.37	30.03	32.83	24.81	17.44	18.54	18.16	14.93	12.69
Yellow pine	23.77	26.54	26.46	26.55	29.82	23.66	19.42	28.71	19.00	12.41	13.87	12.69	9.96	8.46
HARDWOODS														
Ash	43.82	48.07	48.46	49.54	50.35	42.43	38.18	52.69	30.01	22.15	21.21	24.44	18.77	15.84
Basswood	39.84	37.07	39.76	41.94	45.60	35.67	33.09	40.03	25.96	18.89	19.20	19.50	16.86	12.84
Beech	27.21	27.84	29.21	29.95	30.22	26.84	26.99	29.98	19.58	14.01	14.09	13.25	(3)	(3)
Birch	41.03	40.80	41.68	43.83	43.33	35.84	31.53	35.79	24.07	16.52	16.61	16.95	15.44	12.50
Chestnut	29.35	29.54	30.37	25.07	29.75	29.29	27.87	32.30	21.54	16.17	16.63	16.12	13.78	13.37
Cottonwood	30.92	34.47	26.70	29.43	30.19	26.95	25.05	32.24	23.19	17.36	18.12	18.05	14.92	10.37
Elm	36.22	37.13	36.41	38.63	43.53	33.28	29.63	36.39	23.89	16.98	17.13	17.52	14.45	11.47
Gum, red and sap	32.81	33.73	31.39	30.24	32.35	27.07	22.46	32.68	19.56	12.54	12.11	13.20	10.87	9.63
Hickory	37.08	51.20	39.25	52.24	46.39	36.20	36.60	44.37	29.48	23.35	22.47	30.80	23.94	18.78
Maple	35.35	37.21	39.18	40.36	41.59	33.52	30.34	35.56	23.16	15.21	15.49	15.77	14.94	11.83
Oak	35.72	35.67	37.00	36.13	39.08	34.01	30.56	37.87	24.49	18.73	19.14	20.50	17.51	13.78
Sycamore	29.31	29.49	31.11	29.31	30.25	25.29	22.55	30.32	18.68	13.86	13.16	14.87	(3)	11.04
Tupelo	24.45	26.71	24.66	25.86	24.90	22.86	18.59	28.42	18.06	12.25	12.46	11.87	(3)	(3)
Walnut	111.64	113.57	111.53	103.66	109.38	80.08	88.83	72.13	72.99	48.37	31.70	43.79	45.64	36.49
Yellow poplar	38.58	38.63	43.44	44.38	51.29	39.18	37.31	41.65	27.17	22.45	25.46	25.39	18.99	14.03

[1] The Principal Lumber Industries—Lumber and Timber Products, Planing Mill Products, Boxes, Wooden Cooperage Census of Manufactures: 1927; Bureau of the Census, Department of Commerce, Washington, D. C. (Compiled in coöperation with The United States Department of Agriculture, Forest Service.)

[2] Including minor species.

[3] No data.

TABLE 142

WOOD CONSUMED IN MANUFACTURE OF VENEERS, BY KINDS OF WOOD: 1927, 1925, AND 1923[1]

Kind of Wood	Quantity (M Feet Log Scale)			Per Cent Distribution		
	1927	1925	1923	1927	1925	1923
Total	961,561	734,599	645,793	100.0	100.0	100.0
Domestic:						
Red gum	250,247	237,465	220,703	26.0	32.3	34.2
Tupelo	113,729	48,311	36,396	11.8	6.6	5.6
Douglas fir	101,220	101,869	55,123	10.5	13.9	8.5
Yellow pine	92,153	45,818	65,100	9.6	6.2	10.1
Yellow poplar	56,899	50,770	45,376	5.9	6.9	7.0
Spruce	53,642	20,033	11,273	5.6	2.7	1.7
Birch	51,331	51,490	43,936	5.3	7.0	6.8
Cottonwood	43,456	39,869	40,404	4.5	5.4	6.3
Maple	24,706	23,922	23,310	2.6	3.3	3.6
Walnut	20,786	17,573	15,452	2.2	2.4	2.4
Oak	19,502	20,661	25,274	2.0	2.8	3.9
Cedar	19,409	17,093	11,137	2.0	2.3	1.7
Elm	16,945	8,503	9,570	1.8	1.2	1.5
Western pine	13,379	4,876	4,531	1.4	.7	.7
Basswood	11,885	9,413	8,771	1.2	1.3	1.4
Beech	11,268	4,708	5,210	1.2	.6	.8
Sycamore	6,192	4,836	4,182	.6	.7	.6
Magnolia	4,666	3,786	1,439	.5	.5	.2
White fir	4,059	(2)	(2)	.4	(2)	(2)
Cypress	3,450	4,511	3,617	.4	.6	.6
White pine	3,027	(2)	(2)	.3	(2)	(2)
Ash	1,262	1,103	1,114	.1	.2	.2
Other	[3] 20,780	4,255	3,536	2.2	.6	.5
Imported:						
Mahogany	11,954	7,471	6,664	1.2	1.0	1.0
Spanish cedar	4,829	5,149	2,714	.5	.7	.4
Other	[4] 785	1,114	961	.1	.1	.2

[1] The Principal Lumber Industries—Lumber and Timber Products, Planing Mill Products, Boxes, Wooden Cooperage; Census of Manufactures: 1927; Bureau of the Census, Department of Commerce, Washington, D. C. (Compiled in coöperation with The United States Department of Agriculture, Forest Service.)

[2] Included in "Other" domestic.

[3] Alder, bay, butternut, cherry, chestnut, hackberry, hemlock, hickory, holly, myrtle, pecan, redwood, sugar pine, willow, and 16,649 M feet of wood not specified.

[4] African walnut, ebony, English oak, gonzales alves, lauan, madrona, Mexican cedar, oriental walnut, padauk, Philippine wood, rosewood, salano, satinwood, teak, thuya, Zebrawood, and 146 M feet of foreign woods not specified.

TABLE 143

WOOD CONSUMED AND VENEERS PRODUCED, BY KINDS OF WOOD: 1927[1]

Kind of Wood	Total Quantity of Logs Used, M Feet Log Scale	Logs Used and Veneers Produced—Both Items Reported		Logs Used—Veneer Production Not Reported, M Feet Log Scale
		Logs Used, M Feet Log Scale	Veneers Produced, M Square Feet	
Aggregate	961,561	676,067	5,347,788	285,494
Domestic, total	943,993	663,349	5,164,935	280,644
Ash	1,262	1,048	6,485	214
Basswood	11,885	9,692	70,213	2,193
Beech	11,268	3,258	41,057	8,010
Birch	51,331	45,777	507,803	5,554
Cedar	19,409	19,346	172,866	63
Cottonwood	43,456	35,774	325,084	7,682
Cypress	3,450	1,846	32,254	1,604
Douglas fir	101,220	101,220	599,138	....
Elm	16,945	7,054	78,411	9,891
Magnolia	4,666	4,123	42,250	543
Maple	24,706	13,710	143,341	10,996
Oak	19,502	17,057	137,638	2,445
Red gum	250,247	150,658	1,046,445	99,589
Spruce	53,642	49,072	324,099	4,570
Sycamore	6,192	4,947	57,820	1,245
Tupelo	113,729	69,398	408,360	44,331
Walnut	20,786	20,319	386,603	467
Western pine	13,379	13,125	76,651	254
White pine	3,027	39	197	2,988
White fir	4,059	4,059	21,141	....
Yellow pine	92,153	36,468	199,185	55,685
Yellow poplar	56,899	50,351	454,056	6,548
Other [2]	20,780	5,008	33,838	15,772
Imported, total	17,568	12,718	182,853	4,850
Mahogany	11,954	7,140	141,707	4,814
Spanish Cedar	4,829	4,829	32,887	....
Other	785	749	8,259	36

[1] The Principal Lumber Industries—Lumber and Timber Products, Planing Mill Products, Boxes, Wooden Cooperage; Census of Manufactures: 1927; Bureau of the Census, Department of Commerce, Washington, D. C. (Compiled in coöperation with The United States Department of Agriculture, Forest Service.)

[2] Includes 16,649 M feet, kinds of wood not specified.

TABLE 144

WOOD CONSUMED IN MANUFACTURE OF VENEERS, FOR SPECIFIED YEARS: 1905 TO 1927 [1]

Year	Quantity (M Feet Log Scale)	Year	Quantity (M Feet Log Scale)	Year	Quantity (M Feet Log Scale)
1927	961,561	1919	576,581	1908	382,542
1925	734,599	1911	444,886	1907	348,523
1923	645,793	1910	477,479	1906	329,186
1921	400,388	1909	435,981	1905	181,146

[1] Compiled by the Forest Service, United States Department of Agriculture.

TABLE 145

WOOD CONSUMED IN MANUFACTURE OF VENEERS, FOR SELECTED STATES: 1927, 1925, AND 1923 [1]

State	Quantity (M Feet Log Scale)			Per Cent Distribution		
	1927	1925	1923	1927	1925	1923
United States	961,561	734,599	645,793	100.0	100.0	100.0
Washington	140,319	112,484	53,510	14.6	15.3	8.3
Mississippi	80,218	57,268	45,496	8.3	7.8	7.0
North Carolina	78,171	64,640	53,196	8.1	8.8	8.2
Florida	77,321	29,999	49,016	8.0	4.1	7.6
Arkansas	57,611	58,122	64,117	6.0	7.9	9.9
Alabama	41,424	38,561	43,214	4.3	5.2	6.7
Georgia	38,646	11,412	17,092	4.0	1.5	2.6
Wisconsin	37,864	34,292	37,513	3.9	4.7	5.8
South Carolina	35,311	29,669	20,783	3.7	4.0	3.2
Louisiana	35,012	34,395	23,728	3.6	4.7	3.7
Virginia	33,319	26,416	21,179	3.5	3.6	3.3
Oregon	32,091	29,793	26,369	3.3	4.0	4.1
Texas	29,216	5,711	6,564	3.0	.8	1.0
New York	27,364	24,095	16,382	2.8	3.3	2.5
Tennessee	25,586	40,454	30,983	2.7	5.5	4.8
Indiana	25,092	15,474	18,001	2.6	2.1	2.8
Kentucky	24,193	23,309	25,020	2.5	3.2	3.9
Missouri	20,825	17,380	21,811	2.2	2.4	3.4
Michigan	20,811	18,096	20,068	2.2	2.5	3.1
California	18,379	10,454	(2)	1.9	1.4	(2)
Ohio	13,259	4,360	3,163	1.4	.6	.5
Vermont	12,217	10,255	10,505	1.3	1.4	1.6
Illinois	11,414	11,967	13,722	1.2	1.6	2.1
Maine	11,124	(2)	(2)	1.2	(2)	(2)
Maryland	6,094	3,366	4,551	.6	.5	.7
Other States [3]	28,680	22,627	19,810	3.0	3.1	3.1

[1] The Principal Lumber Industries—Lumber and Timber Products, Planing Mill Products, Boxes, Wooden Cooperage; Census of Manufacturers: 1927; Bureau of the Census, Department of Commerce, Washington, D. C. (Compiled in coöperation with The United States Department of Agriculture, Forest Service.)

[2] Included in "Other States."

[3] For 1927—Colorado, Connecticut, Delaware, Iowa, Kansas, Massachusetts, Minnesota, New Hampshire, New Jersey, Pennsylvania, Rhode Island, and West Virginia; 1925—Iowa, Kansas, Maine, Massachusetts, Minnesota, New Hampshire, New Jersey, Pennsylvania, and West Virginia; 1923—California, Delaware, Iowa, Kansas, Maine, Massachusetts, Minnesota, New Hampshire, New Jersey, Pennsylvania, and West Virginia.

TABLE 146

Conversion Factors

The following factors will assist in converting common European lumber measurements into board feet, cubic feet, etc.

	Equivalents.
St. Petersburg standard	165 cu. ft.
	4.67 cu. meters
Logs	1320 bd. ft.
	4.1 loads
Squared timber	1650 bd. ft.
	3.3 loads
Boards	1980 bd. ft.
	3.3 loads
Cubic meter (stere)	35.3 cu. ft.
	0.214 standard
	8 standard railway cross ties
	0.2758 cord of 128 cu. ft.
	0.47–0.37 cord of solid wood
Logs	283 bd. ft
	0.882 load
Squared timber	353 bd. ft.
	0.706 load
Boards	424 bd. ft.
	0.706 load
Softwoods	5.8 quintals
Hardwoods	7.7 quintals
Cubic meter "au reel"	0.20–0.30 cu. meters of sawed lumber
Metric ton	1000 kilos
	10 quintals
	2204.6 lb.
Logs:	
Softwoods	490 bd. ft.
Hardwoods	367 bd. ft.
Squared timber:	
Softwoods	612 bd. ft.
Hardwoods	459 bd. ft.
Boards:	
Softwoods	753 bd. ft.
Hardwoods	551 bd. ft.
Quintal	100 kilos
	220.46 lb.
Logs:	
Softwoods	49 bd. ft.
Hardwoods	37 bd. ft.
Squared timber:	
Softwoods	61 bd. ft.
Hardwoods	45 bd. ft.

	Equivalents.
Boards:	
Softwoods	74 bd. ft.
Hardwoods	55 bd. ft.
1000 bd. ft	83.3 cu. ft.
Logs	3.53 cu. m.
	31.125 loads
	0.758 standard
Squared timber	2.83 cu. m.
	2 loads
	0.606 standard
Boards	2.36 cu. m.
	1.666 loads
	0.505 standard
Load:	
Logs	40 cu. ft.
	1.133 cu. ft.
	320 bd. ft.
	0.242 standard
Squared timber	50 cu. ft.
	1.416 cu. m
	500 bd. ft.
	0.303 standard
Boards	50 cu. ft.
	1.416 cu. m.
	600 bd. ft.
	0.303 standard
Cubic foot:	
Logs	6 bd. ft.
Squared timber	12 bd. ft.
Boards	12 bd. ft.
Wagon or carload	22 cu. m.
Logs	6226 bd. ft.
Squared timber	7766 bd. ft.
Boards	9328 bd. ft.
Cord:	
Space	128 cu. ft.
	3.624 cu. m., or steres
Shipping ton	40 cu. ft. (round timber)
Hectare	2.47 acres
Acre	0.4047 hec.
Inch	25.4 mm.
Foot	304.8 mm.
	30.48 cm.
French foot	13.12 in. (⅓ m.)

TABLE 147

LUMBER CONVERSION TABLE [1]—FEET AND INCHES—METERS

1 Foot = .305 Meters

CONVERSION OF FEET AND INCHES INTO METERS

Feet	*Inches*											
	0	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
0	.000	.025	.051	.076	.102	.127	.152	.178	.203	.229	.254	.279
1	.305	.330	3.56	.381	.406	.432	.457	.483	.508	.533	.559	.584
2	.610	.635	.660	.686	.711	.737	.762	.787	.813	.838	.864	.889
3	.914	.940	.965	.991	1.016	1.041	1.067	1.092	1.118	1.143	1.168	1.194
4	1.219	1.245	1.270	1.295	1.321	1.346	1.372	1.397	1.422	1.448	1.473	1.499
5	1.524	1.549	1.575	1.600	1.626	1.651	1.676	1.702	1.727	1.753	1.778	1.803
6	1.829	1.854	1.880	1.905	1.930	1.956	1.981	2.007	2.032	2.057	2.083	2.108
7	2.134	2.159	2.184	2.210	2.235	2.261	2.286	2.311	2.337	2.362	2.388	2.413
8	2.438	2.464	2.489	2.515	2.540	2.565	2.591	2.616	2.642	2.667	2.692	2.718
9	2.743	2.769	2.794	2.819	2.845	2.870	2.896	2.921	2.946	2.972	2.997	3.023
10	3.048	3.073	3.099	3.124	3.150	3.175	3.200	3.226	3.251	3.277	3.302	3.327
11	3.353	3.378	3.404	3.429	3.454	3.480	3.505	3.531	3.556	3.581	3.607	3.632
12	3.658	3.683	3.708	3.734	3.759	3.785	3.810	3.835	3.861	3.886	3.912	3.937
13	3.962	3.988	4.013	4.039	4.064	4.089	4.115	4.140	4.166	4.191	4.216	4.242
14	4.267	4.293	4.318	4.343	4.369	4.394	4.420	4.445	4.470	4.496	4.521	4.547
15	4.572	4.597	4.623	4.648	4.674	4.699	4.724	4.750	4.775	4.801	4.826	4.851
16	4.877	4.902	4.928	4.953	4.978	5.004	5.029	5.055	5.080	5.105	5.131	5.156
17	5.182	5.207	5.232	5.258	5.283	5.309	5.334	5.359	5.385	5.410	5.436	5.461
18	5.486	5.512	5.537	5.563	5.588	5.613	5.639	5.664	5.690	5.715	5.740	5.766
19	5.791	5.817	5.842	5.867	5.893	5.918	5.944	5.969	5.994	6.020	6.045	6.071
20	6.096	6.121	6.147	6.172	6.198	6.223	6.248	6.274	6.299	6.325	6.350	6.375
21	6.401	6.426	6.452	6.477	6.502	6.528	6.553	6.579	6.604	6.629	6.655	6.680
22	6.706	6.731	6.756	6.782	6.807	6.833	6.858	6.883	6.909	6.934	6.960	6.985
23	7.010	7.036	7.061	7.087	7.112	7.137	7.163	7.188	7.214	7.239	7.264	7.290
24	7.315	7.341	7.366	7.391	7.417	7.442	7.468	7.493	7.518	7.544	7.569	7.595
25	7.620	7.645	7.671	7.696	7.722	7.747	7.772	7.798	7.823	7.849	7.874	7.899
26	7.925	7.950	7.976	8.001	8.026	8.052	8.077	8.103	8.128	8.153	8.179	8.204
27	8.230	8.255	8.280	8.306	8.331	8.357	8.382	8.407	8.433	8.458	8.484	8.509
28	8.534	8.560	8.585	8.611	8.636	8.661	8.687	8.712	8.738	8.763	8.788	8.814
29	8.839	8.865	8.890	8.915	8.941	8.966	8.992	9.017	9.042	9.068	9.093	9.119
30	9.144	9.169	9.195	9.220	9.246	9.271	9.296	9.322	9.347	9.373	9.398	9.423
31	9.449	9.474	9.500	9.525	9.550	9.576	9.601	9.627	9.652	9.677	9.703	9.728
32	9.754	9.779	9.804	9.830	9.855	9.881	9.906	9.931	9.957	9.982	10.008	10.033
33	10.058	10.084	10.109	10.135	10.160	10.185	10.211	10.236	10.262	10.287	10.312	10.338
34	10.363	10.389	10.414	10.439	10.465	10.490	10.516	10.541	10.566	10.592	10.617	10.643
35	10.668	10.693	10.719	10.744	10.770	10.795	10.820	10.846	10.871	10.897	10.922	10.947
36	10.973	10.998	11.024	11.049	11.074	11.100	11.125	11.151	11.176	11.201	11.227	11.252
37	11.278	11.303	11.328	11.354	11.379	11.405	11.430	11.455	11.481	11.506	11.532	11.557
38	11.582	11.608	11.633	11.659	11.684	11.709	11.735	11.760	11.787	11.811	11.836	11.862
39	11.887	11.913	11.938	11.963	11.989	12.014	12.040	12.065	12.090	12.116	12.141	12.167
40	12.192	12.217	12.243	12.268	12.294	12.319	12.344	12.370	12.395	12.421	12.446	12.471

To reduce meters to centimeters multiply by 100 (move decimal point two places to right).

To reduce meters to millimeters multiply by 1,000 (move decimal point three places to right).

[1] Issued by the Lumber Division of the Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C. Prepared by Bureau of Standards.

TABLE 148

LUMBER CONVERSION TABLE [1]—INCHES (BY SIXTEENTHS)—MILLIMETERS

1 Inch = 25.4 Millimeters

CONVERSION OF INCHES (BY SIXTEENTHS) INTO MILLIMETERS

Inches	0	1/16	1/8	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16
0	0.0	1.6	3.2	4.8	6.4	7.9	9.5	11.1	12.7	14.3	15.9	17.5	19.1	20.6	22.2	23.8
1	25.4	27.0	28.6	30.2	31.8	33.3	34.9	36.5	38.1	39.7	41.3	42.9	44.5	46.0	47.6	49.2
2	50.8	52.4	54.0	55.6	57.2	58.7	60.3	61.9	63.5	65.1	66.7	68.3	69.9	71.4	73.0	74.6
3	76.2	77.8	79.4	81.0	82.6	84.1	85.7	87.3	88.9	90.5	92.1	93.7	95.3	96.8	98.4	100.0
4	101.6	103.2	104.8	106.4	108.0	109.5	111.1	112.7	114.3	115.9	117.5	119.1	120.7	122.2	123.8	125.4
5	127.0	128.6	130.2	131.8	133.4	134.9	136.5	138.1	139.7	141.3	142.9	144.5	146.1	147.6	149.2	150.8
6	152.4	154.0	155.6	157.2	158.8	160.3	161.9	163.5	165.1	166.7	168.3	169.9	171.5	173.0	174.6	176.2
7	177.8	179.4	181.0	182.6	184.2	185.7	187.3	188.9	190.5	192.1	193.7	195.3	196.9	198.4	200.0	201.6
8	203.2	204.8	206.4	208.0	209.6	211.1	212.7	214.3	215.9	217.5	219.1	220.7	222.3	223.8	225.4	227.0
9	228.6	230.2	231.8	233.4	235.0	236.5	238.1	239.7	241.3	242.9	244.5	246.1	247.7	249.2	250.8	252.4
10	254.0	255.6	257.2	258.8	260.4	261.9	263.5	265.1	266.7	268.3	269.9	271.5	273.1	274.6	276.2	277.8
11	279.4	281.0	282.6	284.2	285.8	287.3	288.9	290.5	292.1	293.7	295.3	296.9	298.5	300.0	301.6	303.2
12	304.8	306.4	308.0	309.6	311.2	312.7	314.3	315.9	317.5	319.1	320.7	322.3	323.9	325.4	327.0	328.6
13	330.2	331.8	333.4	335.0	336.6	338.1	339.7	341.3	342.9	344.5	346.1	347.7	349.3	350.8	353.4	354.0
14	355.6	357.2	358.8	360.4	362.0	363.5	365.1	366.7	368.3	369.9	371.5	373.1	374.7	376.2	377.8	379.4
15	381.0	382.6	384.2	385.8	387.4	388.9	390.5	392.1	393.7	395.3	396.9	398.5	400.1	401.6	403.2	404.8
16	406.4	408.0	409.6	411.2	412.8	414.3	415.9	417.5	419.1	420.7	422.3	423.9	425.5	427.0	428.6	430.2
17	431.8	433.4	435.0	436.6	438.2	439.7	441.3	442.9	444.5	446.1	447.7	449.3	450.9	452.4	454.0	455.6
18	457.2	458.8	460.4	462.0	463.6	465.1	466.7	468.3	469.9	471.5	473.1	474.7	476.3	477.8	479.4	481.0
19	482.6	484.2	485.8	487.4	489.0	490.5	492.1	493.7	495.3	496.9	498.5	500.1	501.7	503.2	504.8	506.4
20	508.0	509.6	511.2	512.8	514.4	515.9	517.5	519.1	520.7	522.3	523.9	525.5	527.1	528.6	530.2	531.8
21	533.4	535.0	536.6	538.2	539.8	541.3	542.9	544.5	546.1	547.7	549.3	550.9	552.5	554.0	555.6	557.2
22	558.8	560.4	562.0	563.6	565.2	566.7	568.3	569.9	571.5	573.1	574.7	576.3	577.9	579.4	581.0	582.6
23	584.2	585.8	587.4	589.0	590.6	592.1	593.7	595.3	596.9	598.5	600.1	601.7	603.3	604.8	606.4	608.0
24	609.6	611.2	612.8	614.4	616.0	617.5	619.1	620.7	622.3	623.9	625.5	627.1	628.7	630.2	631.8	633.4

To convert millimeters to centimeters divide by 10 (move decimal point one place to left).
To convert centimeters to meters divide by 100 (move decimal point two places to left).

Other conversion tables issued by Lumber Division:
Petrograd Standards—Board Feet.
Cubic Meters—Board Feet.

[1] Issued by the Lumber Division of the Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C. Prepared by Bureau of Standards.

TABLE 149

LUMBER CONVERSION TABLE [1]—CUBIC METERS—BOARD FEET
(Quantities and Prices)

1 Cubic Meter of Sawed Lumber= 424 Board Feet

Cubic Meters	Board Feet	Cubic Meters	Board Feet	Cubic Meters	Board Feet	Cubic Meters	Board Feet	Cubic Meters	Board Feet	Cubic Meters	Board Feet
		60	25,440	120	50,880	180	76,320	240	101,760	300	127,200
1	424	61	25,864	121	51,304	181	76,744	241	102,184	301	127,624
2	848	62	26,288	122	51,728	182	77,168	242	102,608	302	128,048
3	1,272	63	26,712	123	52,152	183	77,592	243	103,032	303	128,472
4	1,696	64	27,136	124	52,576	184	78,016	244	103,456	304	128,896
5	2,120	65	27,560	125	53,000	185	78,440	245	103,880	305	129,320
6	2,544	66	27,984	126	53,424	186	78,864	246	104,304	306	129,744
7	2,968	67	28,408	127	53,848	187	79,288	247	104,728	307	130,168
8	3,392	68	28,832	128	54,272	188	79,712	248	105,152	308	130,592
9	3,816	69	29,256	129	54,696	189	80,136	249	105,576	309	131,016
10	4,240	70	29,680	130	55,120	190	80,560	250	106,000	310	131,440
11	4,664	71	30,104	131	55,544	191	80,984	251	106,424	311	131,864
12	5,088	72	30,528	132	55,968	192	81,408	252	106,848	312	132,288
13	5,512	73	30,952	133	56,392	193	81,832	253	107,272	313	132,712
14	5,936	74	31,376	134	56,816	194	82,256	254	107,696	314	133,136
15	6,360	75	31,800	135	57,240	195	82,680	255	108,120	315	133,560
16	6,784	76	32,224	136	57,664	196	83,104	256	108,544	316	133,984
17	7,208	77	32,648	137	58,088	197	83,528	257	108,968	317	134,408
18	7,632	78	33,072	138	58,512	198	83,952	258	109,392	318	134,832
19	8,056	79	33,496	139	58,936	199	84,376	259	109,816	319	135,256
20	8,480	80	33,920	140	59,360	200	84,800	260	110,240	320	135,680
21	8,904	81	34,344	141	59,784	201	85,224	261	110,664	321	136,104
22	9,328	82	34,768	142	60,208	202	85,648	262	111,088	322	136,528
23	9,752	83	35,192	143	60,632	203	86,072	263	111,512	323	136,952
24	10,176	84	35,616	144	61,056	204	86,496	264	111,936	324	137,376
25	10,600	85	36,040	145	61,480	205	86,920	265	112,360	325	137,800
26	11,024	86	36,464	146	61,904	206	87,344	266	112,784	326	138,224
27	11,448	87	36,888	147	62,328	207	87,768	267	113,208	327	138,648
28	11,872	88	37,312	148	62,752	208	88,192	268	113,632	328	139,072
29	12,296	89	37,736	149	63,176	209	88,616	269	114,056	329	139,496
30	12,720	90	38,160	150	63,600	210	89,040	270	114,480	330	139,920
31	13,144	91	38,584	151	64,024	211	89,464	271	114,904	331	140,344
32	13,568	92	39,008	152	64,448	212	89,888	272	115,328	332	140,768
33	13,992	93	39,432	153	64,872	213	90,312	273	115,752	333	141,192
34	14,416	94	39,856	154	65,296	214	90,736	274	116,176	334	141,616
35	14,840	95	40,280	155	65,720	215	91,160	275	116,600	335	142,040
36	15,264	96	40,704	156	66,144	216	91,584	276	117,024	336	142,464
37	15,688	97	41,128	157	66,568	217	92,008	277	117,448	337	142,888
38	16,112	98	41,552	158	66,992	218	92,432	278	117,872	338	143,312
39	16,536	99	41,976	159	67,416	219	92,856	279	118,296	339	143,736
40	16,960	100	42,400	160	67,840	220	93,280	280	118,720	340	144,160
41	17,384	101	42,824	161	68,264	221	93,704	281	119,144	341	144,584
42	17,808	102	43,248	162	68,688	222	94,128	282	119,568	342	145,008
43	18,232	103	43,672	163	69,112	223	94,552	283	119,992	343	145,432
44	18,656	104	44,096	164	69,536	224	94,976	284	120,416	344	145,856
45	19,080	105	44,520	165	69,960	225	95,400	285	120,840	345	146,280
46	19,504	106	44,944	166	70,384	226	95,824	286	121,264	346	146,704
47	19,928	107	45,368	167	70,808	227	96,248	287	121,688	347	147,128
48	20,352	108	45,792	168	71,232	228	96,672	288	122,112	348	147,552
49	20,776	109	46,216	169	71,656	229	97,096	289	122,536	349	147,976
50	21,200	110	46,640	170	72,080	230	97,520	290	122,960	350	148,400
51	21,624	111	47,064	171	72,504	231	97,944	291	123,384	351	148,824
52	22,048	112	47,488	172	72,928	232	98,368	292	123,808	352	149,248
53	22,472	113	47,912	173	73,352	233	98,792	293	124,232	353	149,672
54	22,896	114	48,336	174	73,776	234	99,216	294	124,656	354	150,096
55	23,320	115	48,760	175	74,200	235	99,640	295	125,080	355	150,520
56	23,744	116	49,184	176	74,624	236	100,064	296	125,504	356	150,944
57	24,168	117	49,608	177	75,048	237	100,488	297	125,928	357	151,368
58	24,592	118	50,032	178	75,472	238	100,912	298	126,352	358	151,792
59	25,016	119	50,456	179	75,896	239	101,336	299	126,776	359	152,216

[1] Issued by the Lumber Division of the Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C.

TABLE 149—*Continued*

Cubic Meters	*Board Feet*	*Cubic Meters*	*Board Feet*	*Cubic Meters*	*Board Feet*	*Cubic Meters*	*Board Feet*	*Cubic Meters*	*Board Feet*	*Cubic Meters*	*Board Feet*
360	152,640	425	180,200	490	207,760	555	235,320	620	262,880	685	290,440
361	153,064	426	180,624	491	208,184	556	235,744	621	263,304	586	290,864
362	153,488	427	181,048	492	208,608	557	236,168	622	263,728	687	291,288
363	153,912	428	181,472	493	209,032	558	236,592	623	264,152	688	291,712
364	154,336	429	181,896	494	209,456	559	237,016	624	264,576	689	292,136
365	154,760			495	209,880			625	265,000		
366	155,184	430	182,320	496	210,304	560	237,440	626	265,424	690	292,560
367	155,608	431	182,744	497	210,728	561	237,864	627	265,848	691	292,984
368	156,032	432	183,168	498	211,152	562	238,288	628	266,272	692	293,408
369	156,456	433	183,592	499	211,576	563	238,712	629	266,696	693	293,832
		434	184,016			564	239,136			694	294,256
370	156,880	435	184,440	500	212,000	565	239,560	630	267,120	695	294,680
371	157,304	436	184,864	501	212,424	566	239,984	631	267,544	696	295,104
372	157,728	437	185,288	502	212,848	567	240,408	632	267,968	697	295,528
373	158,152	438	185,712	503	213,272	568	240,832	633	268,392	698	295,952
374	158,576	439	186,136	504	213,696	569	241,256	634	268,816	699	296,376
375	159,000			505	214,120			635	269,240		
376	159,424	440	186,560	506	214,544	570	241,680	636	269,664	700	296,800
377	159,848	441	186,984	507	214,968	571	242,104	637	270,088	701	297,224
378	160,272	442	187,408	508	215,392	572	242,528	638	270,512	702	297,648
379	160,696	443	187,832	509	215,816	573	242,952	639	270,936	703	298,072
		444	188,256			574	243,376			704	298,496
380	161,120	445	188,680	510	216,240	575	243,800	640	271,360	705	298,920
381	161,544	446	189,104	511	216,664	576	244,224	641	271,784	706	299,344
382	161,968	447	189,528	512	217,088	577	244,648	642	272,208	707	299,768
383	162,392	448	189,952	513	217,512	578	245,072	643	272,632	708	300,192
384	162,816	449	190,376	514	217,936	579	245,496	644	273,056	709	300,616
385	163,240			515	218,360			645	273,480		
386	163,664	450	190,800	516	218,784	580	245,920	646	273,904	710	301,040
387	164,088	451	191,224	517	219,208	581	246,344	647	274,328	711	301,464
388	164,512	452	191,648	518	219,632	582	246,768	648	274,752	712	301,888
389	164,936	453	192,072	519	220,056	583	247,192	649	275,176	713	302,312
		454	192,496			584	247,616			714	302,736
390	165,360	455	192,920	520	220,480	585	248,040	650	275,600	715	303,160
391	165,784	456	193,344	521	220,904	586	248,464	651	276,024	716	303,584
392	166,208	457	193,768	522	221,328	587	248,888	652	276,448	717	304,008
393	166,632	458	194,192	523	221,752	588	249,312	653	276,872	718	304,432
394	167,056	459	194,616	524	222,176	589	249,736	654	277,296	719	304,856
395	167,480			525	222,600			655	277,720		
396	167,904	460	195,040	526	223,024	590	250,160	656	278,144	720	305,280
397	168,328	461	195,464	527	223,448	591	250,584	657	278,568	721	305,704
398	168,752	462	195,888	528	223,872	592	251,008	658	278,992	722	306,128
399	169,176	463	196,312	529	224,296	593	251,432	659	279,416	723	306,552
		464	196,736			594	251,856			724	306,976
400	169,600	465	197,160	530	224,720	595	252,280	660	279,840	725	307,400
401	170,024	466	197,584	531	225,144	596	252,704	661	280,264	726	307,824
402	170,448	467	198,008	532	225,568	597	253,128	662	280,688	727	308,248
403	170,872	468	198,432	533	225,992	598	253,552	663	281,112	728	308,672
404	171,296	469	198,856	534	226,416	599	253,976	664	281,536	729	309,096
405	171,720			535	226,840			665	281,960		
406	172,144	470	199,280	536	227,264	600	254,400	666	282,384	730	309,520
407	172,568	471	199,704	537	227,688	601	254,824	667	282,808	731	309,944
408	172,992	472	200,128	538	228,112	602	255,248	668	283,232	732	310,368
409	173,416	473	200,552	539	228,536	603	255,672	669	283,656	733	310,792
		474	200,976			604	256,096			734	311,216
410	173,840	475	201,400	540	228,960	605	256,520	670	284,080	735	311,640
411	174,264	476	201,824	541	229,384	606	256,944	671	284,504	736	312,064
412	174,688	477	202,248	542	229,808	607	257,368	672	284,928	737	312,488
413	175,112	478	202,672	543	230,232	608	257,792	673	285,352	738	312,912
414	175,536	479	203,096	544	230,656	609	258,216	674	285,776	739	313,336
415	175,960			545	231,080			675	286,200		
416	176,384	480	203,520	546	231,504	610	258,640	676	286,624	740	313,760
417	176,808	481	203,944	547	231,928	611	259,064	677	287,048	741	314,184
418	177,232	482	204,368	548	232,352	612	259,488	678	287,472	742	314,608
419	177,656	483	204,792	549	232,776	613	259,912	679	287,896	743	315,032
		484	205,216			614	260,336			744	315,456
420	178,080	485	205,640	550	233,200	615	260,760	680	288,320	745	315,880
421	178,504	486	206,064	551	233,624	616	261,184	681	288,744	746	316,304
422	178,928	487	206,488	552	234,048	617	261,608	682	289,168	747	316,728
423	179,352	488	206,912	553	234,472	618	262,032	683	289,592	748	317,152
424	179,776	489	207,336	554	234,896	619	262,456	684	290,016	749	317,576

TABLE 149—*Concluded*

Cubic Meters	*Board Feet*	*Cubic Meters*	*Board Feet*	*Cubic Meters*	*Board Feet*	*Cubic Meters*	*Board Feet*	*Cubic Meters*	*Board Feet*	*Cubic Meters*	*Board Feet*
750	318,000	792	335,808	834	353,616	876	371,424	918	389,232	960	407,040
751	318,424	793	336,232	835	354,040	877	371,848	919	389,656	961	407,464
752	318,848	794	336,656	836	354,464	878	372,272			962	407,888
753	319,272	795	337,080	837	354,888	879	372,696	920	390,080	963	408,312
754	319,696	796	337,504	838	355,312			921	390,504	964	408,736
755	320,120	797	337,928	839	355,736	880	373,120	922	390,928	965	409,160
756	320,544	798	338,352			881	373,544	923	391,352	966	409,584
757	320,968	799	338,776	840	356,160	882	373,968	924	391,776	967	410,008
758	321,392			841	356,584	883	374,392	925	392,200	968	410,432
759	321,816	800	339,200	842	357,008	884	374,816	926	392,624	969	410,856
		801	339,624	843	357,432	885	375,240	927	393,048		
760	322,240	802	340,048	844	357,856	886	375,664	928	393,472	970	411,280
761	322,664	803	340,472	845	358,280	887	376,088	929	393,896	971	411,704
762	323,088	804	340,896	846	358,704	888	376,512			972	412,128
763	323,512	805	341,320	847	359,128	889	376,936	930	394,320	973	412,552
764	323,936	806	341,744	848	359,552			931	394,744	974	412,976
765	324,360	807	342,168	849	359,976	890	377,360	932	395,168	975	413,400
766	324,784	808	342,592			891	377,784	933	395,592	976	413,824
767	325,208	809	343,016	850	360,400	892	378,208	934	396,016	977	414,248
768	325,632			851	360,824	893	378,632	935	396,440	978	414,672
769	326,056	810	343,440	852	361,248	894	379,056	936	396,864	979	415,096
		811	343,864	853	361,672	895	379,480	937	397,288		
770	326,480	812	344,288	854	362,096	896	379,904	938	397,712	980	415,520
771	326,904	813	344,712	855	362,520	897	380,328	939	398,136	981	415,944
772	327,328	814	345,136	856	362,944	898	380,752			982	416,368
773	327,752	815	345,560	857	363,368	899	381,176	940	398,560	983	416,792
774	328,176	816	345,984	858	363,792			941	398,984	984	417,216
775	328,600	817	346,408	859	364,216	900	381,600	942	399,408	985	417,640
776	329,024	818	346,832			901	382,024	943	399,832	986	418,064
777	329,448	819	347,256	860	364,640	902	382,448	944	400,256	987	418,488
778	329,872			861	365,064	903	382,872	945	400,680	988	418,912
779	330,296	820	347,680	862	365,488	904	383,296	946	401,104	989	419,336
		821	348,104	863	365,912	905	383,720	947	401,528		
780	330,720	822	348,528	864	366,336	906	384,144	948	401,952	990	419,760
781	331,144	823	348,952	865	366,760	907	384,568	949	402,376	991	420,184
782	331,568	824	349,376	866	367,184	908	384,992			992	420,608
783	331,992	825	349,800	867	367,608	909	385,416	950	402,800	993	421,032
784	332,416	826	350,224	868	368,032			951	403,224	994	421,456
785	332,840	827	350,648	869	368,456	910	385,840	952	403,648	995	421,880
786	333,264	828	351,072			911	386,264	953	404,072	996	422,304
787	333,688	829	351,496	870	368,880	912	386,688	954	404,496	997	422,728
788	334,112			871	369,304	913	387,112	955	404,920	998	423,152
789	334,536	830	351,920	872	369,728	914	387,536	956	405,344	999	423,576
		831	352,344	873	370,152	915	387,960	957	405,768		
790	334,960	832	352,768	874	370,576	916	388,384	958	406,192	1000	424,000
791	335,384	833	353,192	875	371,000	917	388,808	959	406,616	1001	424,424

The following examples illustrate the various uses of this table:

Question: How many board feet are 30 cubic meters?
Answer: 12,720 board feet.

Question: How many cubic meters are 216,840 board feet?
Answer: 216,664 board feet= 511.000 cubic meters.
176 board feet= 0.415 cubic meters.
216,840 board feet= 511,415 cubic meters.

In order to find price per cubic meter, insert decimal point in thousands place as per following example:

Question: What is the price per cubic meter when the price per M feet B. M. is $106.00?
Answer: $44.94.

Question: What is the price per cubic meter when the price per M feet B. M. is $52.00?
Answer: $50.00 per M feet B. M.= $21.20 per cubic meter.
2.00 per M feet B. M.= .85 per cubic meter.
52.00 per M feet B. M.= 22.05 per cubic meter.

Question: What is the price per M feet B. M. when the price per cubic meter is $21.00?
Answer: $21.20 per cubic meter= $50.00 per M feet B. M.
less .20 per cubic meter= .47 per M feet B. M.
21.00 per cubic meter= 49.53 per M feet B. M.

TABLE 150

LUMBER CONVERSION TABLE[1]—PETROGRAD STANDARDS—BOARD FEET
(Quantities and Prices)

1 Petrograd Standard = 1,980 Board Feet

Standards	Board Feet	Standards	Board Feet	Standards	Board Feet	Standards	Board Feet	Standards	Board Feet	Standards	Board Feet
1		60	118,800	120	237,600	180	356,400	240	475,200	300	594,000
1	1,980	61	120,780	121	239,580	181	358,380	241	477,180	301	595,980
2	3,960	62	122,760	122	241,560	182	360,360	242	479,160	302	597,960
3	5,940	63	124,740	123	243,540	183	362,340	243	481,140	303	599,940
4	7,920	64	126,720	124	245,520	184	364,320	244	483,120	304	601,920
5	9,900	65	128,700	125	247,500	185	366,300	245	485,100	305	603,900
6	11,880	66	130,680	126	249,480	186	368,280	246	487,080	306	605,880
7	13,860	67	132,660	127	251,460	187	370,260	247	489,060	307	607,860
8	15,840	68	134,640	128	253,440	188	372,240	248	491,040	308	609,840
9	17,820	69	136,620	129	255,420	189	374,220	249	493,020	309	611,820
10	19,800	70	138,600	130	257,400	190	376,200	250	495,000	310	613,800
11	21,780	71	140,580	131	259,380	191	378,180	251	496,980	311	615,780
12	23,760	72	142,560	132	261,360	192	380,160	252	498,960	312	617,760
13	25,740	73	144,540	133	263,340	193	382,140	253	500,940	313	619,740
14	27,720	74	146,520	134	265,320	194	384,120	254	502,920	314	621,720
15	29,700	75	148,500	135	267,300	195	386,100	255	504,900	315	623,700
16	31,680	76	150,480	136	269,280	196	388,080	256	506,880	316	625,680
17	33,660	77	152,460	137	271,260	197	390,060	257	508,860	317	627,660
18	35,640	78	154,440	138	273,240	198	392,040	258	510,840	318	629,640
19	37,620	79	156,420	139	275,220	199	394,020	259	512,820	319	631,620
20	39,600	80	158,400	140	277,200	200	396,000	260	514,800	320	633,600
21	41,580	81	160,380	141	279,180	201	397,980	261	516,780	321	635,580
22	43,560	82	162,360	142	281,160	202	399,960	262	518,760	322	637,560
23	45,540	83	164,340	143	283,140	203	401,940	263	520,740	323	639,540
24	47,520	84	166,320	144	285,120	204	403,920	264	522,720	324	641,520
25	49,500	85	168,300	145	287,100	205	405,900	265	524,700	325	643,500
26	51,480	86	170,280	146	289,080	206	407,880	266	526,680	326	645,480
27	53,460	87	172,260	147	291,060	207	409,860	267	528,660	327	647.460
28	55,440	88	174,240	148	293,040	208	411,840	268	530,640	328	649,440
29	57,420	89	176,220	149	295,020	209	413,820	269	532,620	329	651,420
30	59,400	90	178,200	150	297,000	210	415,800	270	534,600	330	653,400
31	61,380	91	180,180	151	298,980	211	417,780	271	536,580	331	655,380
32	63,360	92	182,160	152	300,960	212	419,760	272	538,560	332	657,360
33	65,340	93	184,140	153	302,940	213	421,740	273	540,540	333	659,340
34	67,320	94	186,120	154	304,920	214	423,720	274	542,520	334	661,320
35	69,300	95	188,100	155	306,900	215	425,700	275	544,500	335	663,300
36	71,280	96	190,080	156	308,880	216	427,680	276	546,480	336	665,280
37	73,260	97	192,060	157	310,860	217	429,660	277	548,460	337	667,260
38	75,240	98	194,040	158	312,840	218	431,640	278	550,440	338	669,240
39	77,220	99	196,020	159	314,820	219	433,620	279	552,420	339	671,220
40	79,200	100	198,000	160	316,800	220	435,600	280	554,400	340	673,200
41	81,180	101	199,980	161	318,780	221	437,580	281	556,380	341	675,180
42	83,160	102	201,960	162	320,760	222	439,560	282	558,360	342	677,160
43	85,140	103	203,940	163	322,740	223	441,540	283	560,340	343	679,140
44	87,120	104	205,920	164	324,720	224	443,520	284	562,320	344	681,120
45	89,100	105	207,900	165	326,700	225	445,500	285	564,300	345	683,100
46	91,080	106	209,880	166	328,680	226	447,480	286	566,280	346	685,080
47	93,060	107	211,860	167	330,660	227	449,460	287	568,260	347	687,060
48	95,040	108	213,840	168	332,640	228	451,440	288	570,240	348	689,040
49	97,020	109	215,820	169	334,620	229	453,420	289	572,220	349	691,020
50	99,000	110	217,800	170	336,600	230	455,400	290	574,200	350	693,000
51	100,980	111	219,780	171	338,580	231	457,380	291	576,180	351	694,980
52	102,960	112	221,760	172	340,560	232	459,360	292	578,160	352	696,960
53	104,940	113	223,740	173	342,540	233	461,340	293	580,140	353	698,940
54	106,920	114	225,720	174	344,520	234	463,320	294	582,120	354	700,920
55	108,900	115	227,700	175	346,500	235	465,300	295	584.100	355	702,900
56	110,880	116	229,680	176	348,480	236	467,280	296	586,080	356	704,880
57	112,860	117	231,660	177	350,460	237	469,260	297	588,060	357	706,860
58	114,840	118	233,640	178	352,440	238	471,240	298	590,040	358	708,840
59	116,820	119	235,620	179	354,420	239	473,220	299	592,020	359	710,820

[1] Issued by the Lumber Division of the Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C.

TABLE 150—*Continued*

Standards	*Board Feet*	*Standards*	*Board Feet*	*Standards*	*Board Feet*	*Standards*	*Board Feet*	*Standards*	*Board Feet*	*Standards*	*Board Feet*
360	712,800	425	841,500	490	970,200	555	1,098,900	620	1,227,600	685	1,356,300
361	714,780	426	843,480	491	972,180	556	1,100,880	621	1,229,580	686	1,358,280
362	716,760	427	845,460	492	974,160	557	1,102,860	622	1,231,560	687	1,360,260
363	718,740	428	847,440	493	976,140	558	1,104,840	623	1,233,540	688	1,362,240
364	720,720	429	849,420	494	978,120	559	1,106,820	624	1,235,520	689	1,364,220
365	722,700			495	980,100			625	1,237,500		
366	724,680	430	851,400	496	982,080	560	1,108,800	626	1,239,480	690	1,366,200
367	726,660	431	853,380	497	984,060	561	1,110,780	627	1,241,460	691	1,368,180
368	728,640	432	855,360	498	986,040	562	1,112,760	628	1,243,440	692	1,370,160
369	730,620	433	857,340	499	988,020	563	1,114,740	629	1,245,420	693	1,372,140
		434	859,320			564	1,116,720			694	1,374,120
370	732,600	435	861,300	500	990,000	565	1,118,700	630	1,247,400	695	1,376,100
371	734,580	436	863,280	501	991,980	566	1,120,680	631	1,249,380	696	1,378,080
372	736,560	437	865,260	502	993,960	567	1,122,660	632	1,251,360	697	1,380,060
373	738,540	438	867,240	503	995,940	568	1,124,640	633	1,253,340	698	1,382,040
374	740,520	439	869,220	504	997,920	569	1,126,620	634	1,255,320	699	1,384,020
375	742,500			505	999,900			635	1,257,300		
376	744,480	440	871,200	506	1,001,880	570	1,128,600	636	1,259,280	700	1,386,000
377	746,460	441	873,180	507	1,003,860	571	1,130,580	637	1,261,260	701	1,387,980
378	748,440	442	875,160	508	1,005,840	572	1,132,560	638	1,263,240	702	1,389,960
379	750,420	443	877,140	509	1,007,820	573	1,134,540	639	1,265,220	703	1,391,940
		444	879,120			574	1,136,520			704	1,393,920
380	752,400	445	881,100	510	1,009,800	575	1,138,500	640	1,267,200	705	1,395,900
381	754,380	446	883,080	511	1,011,780	576	1,140,480	641	1,269,180	706	1,397,880
382	756,360	447	885,060	512	1,013,760	577	1,142,460	642	1,271,160	707	1,399,860
383	758,340	448	887,040	513	1,015,740	578	1,144,440	643	1,273,140	708	1,401,840
384	760,320	449	889,020	514	1,017,720	579	1,146,420	644	1,275,120	709	1,403,820
385	762,300			515	1,019,700			645	1,277,100		
386	764,280	450	891,000	516	1,021,680	580	1,148,400	646	1,279,080	710	1,405,800
387	766,260	451	892,980	517	1,023,660	581	1,150,380	647	1,281,060	711	1,407,780
388	768,240	452	894,960	518	1,025,640	582	1,152,360	648	1,283,040	712	1,409,760
389	770,220	453	896,940	519	1,027,620	583	1,154,340	649	1,285,020	713	1,411,740
		454	898,920			584	1,156,320			714	1,413,720
390	772,200	455	900,900	520	1,029,600	585	1,158,300	650	1,287,000	715	1,415,700
391	774,180	456	902,880	521	1,031,580	586	1,160,280	651	1,288,980	716	1,417,680
392	776,160	457	904,860	522	1,033,560	587	1,162,260	652	1,290,960	717	1,419,660
393	778,140	458	906,840	523	1,035,540	588	1,164,240	653	1,292,940	718	1,421,640
394	780,120	459	908,820	524	1,037,520	589	1,166,220	654	1,294,920	719	1,423,620
395	782,100			525	1,039,500			655	1,296,900		
396	784,080	460	910,800	526	1,041,480	590	1,168,200	656	1,298,880	720	1,425,600
397	786,060	461	912,780	527	1,043,460	591	1,170,180	657	1,300,860	721	1,427,580
398	788,040	462	914,760	528	1,045,440	592	1,172,160	658	1,302,840	722	1,429,560
399	790,020	463	916,740	529	1,047,420	593	1,174,140	659	1,304,820	723	1,431,540
		464	918,720			594	1,176,120			724	1,433,520
400	792,000	465	920,700	530	1,049,400	595	1,178,100	660	1,306,800	725	1,435,500
401	793,980	466	922,680	531	1,051,380	596	1,180,080	661	1,308,780	726	1,437,480
402	795,960	467	924,660	532	1,053,360	597	1,182,060	662	1,310,760	727	1,439,460
403	797,940	468	926,640	533	1,055,340	598	1,184,040	663	1,312,740	728	1,441,440
404	799,920	469	928,620	534	1,057,320	599	1,186,020	664	1,314,720	729	1,443,420
405	801,900			535	1,059,300			665	1,316,700		
406	803,880	470	930,600	536	1,061,280	600	1,188,000	666	1,318,680	730	1,445,400
407	805,860	471	932,580	537	1,063,260	601	1,189,980	667	1,320,660	731	1,447,380
408	807,840	472	934,560	538	1,065,240	602	1,191,960	668	1,322,640	732	1,449,360
409	809,820	473	936,540	539	1,067,220	603	1,193,940	669	1,324,620	733	1,451,340
		474	938,520			604	1,195,920			734	1,453,320
410	811,800	475	940,500	540	1,069,200	605	1,197,900	670	1,326,600	735	1,455,300
411	813,780	476	942,480	541	1,071,180	606	1,199,880	671	1,328,580	736	1,457,280
412	815,760	477	944,460	542	1,073,160	607	1,201,860	672	1,330,560	737	1,459,260
413	817,740	478	946,440	543	1,075,140	608	1,203,840	673	1,332,540	738	1,461,240
414	819,720	479	948,420	544	1,077,120	609	1,205,820	674	1,334,520	739	1,463,220
415	821,700			545	1,079,100			675	1,336,500		
416	823,680	480	950,400	546	1,081,080	610	1,207,800	676	1,338,480	740	1,465,200
417	825,660	481	952,380	547	1,083,060	611	1,209,780	677	1,340,460	741	1,467,180
418	827,640	482	954,360	548	1,085,040	612	1,211,760	678	1,342,440	742	1,469,160
419	829,620	483	956,340	549	1,087,020	613	1,213,740	679	1,344,420	743	1,471,140
		484	958,320			614	1,215,720			744	1,473,120
420	831,600	485	960,300	550	1,089,000	615	1,217,700	680	1,346,400	745	1,475,100
421	833,580	486	962,280	551	1,090,980	616	1,219,680	681	1,348,380	746	1,477,080
422	835,560	487	964,260	552	1,092,960	617	1,221,660	682	1,350,360	747	1,479,060
423	837,540	488	966,240	553	1,094,940	618	1,223,640	683	1,352,340	748	1,481,040
424	839,520	489	968,220	554	1,096,920	619	1,225,620	684	1,354,320	749	1,483,020

TABLE 150—*Concluded*

Standards	*Board Feet*	*Standards*	*Board Feet*	*Standards*	*Board Feet*	*Standards*	*Board Feet*	*Standards*	*Board Feet*	*Standards*	*Board Feet*
750	1,485,000	792	1,568,160	834	1,651,320	876	1,734,480	918	1,817,640	960	1,900,800
751	1,486,980	793	1,570,140	835	1,653,300	877	1,736,460	919	1,819,620	961	1,902,780
752	1,488,960	794	1,572,120	836	1,655,280	878	1,738,440			962	1,904,760
753	1,490,940	795	1,574,100	837	1,657,260	879	1,740,420	920	1,821,600	963	1,906,740
754	1,492,920	796	1,576,080	838	1,659,240			921	1,823,580	964	1,908,720
755	1,494,900	797	1,578,060	839	1,661,220	880	1,742,400	922	1,825,560	965	1,910,700
756	1,496,880	798	1,580,040			881	1,744,380	923	1,827,540	966	1,912,680
757	1,498,860	799	1,582,020	840	1,663,200	882	1,746,360	924	1,829,520	967	1,914,660
758	1,500,840			841	1,665,180	883	1,748,340	925	1,831,500	968	1,916,640
759	1,502,820	800	1,584,000	842	1,667,160	884	1,750,320	926	1,833,480	969	1,918,620
		801	1,585,980	843	1,669,140	885	1,752,300	927	1,835,460		
760	1,504,800	802	1,587,960	844	1,671,120	886	1,754,280	928	1,837,440	970	1,920,600
761	1,506,780	803	1,589,940	845	1,673,100	887	1,756,260	929	1,839,420	971	1,922,580
762	1,508,760	804	1,591,920	846	1,675,080	888	1,758,240			972	1,924,560
763	1,510,740	805	1,593,900	847	1,677,060	889	1,760,220	930	1,841,400	973	1,926,540
764	1,512,720	806	1,595,880	848	1,679,040			931	1,843,380	974	1,928,520
765	1,514,700	807	1,597,860	849	1,681,020	890	1,762,200	932	1,845,360	975	1,930,500
766	1,516,680	808	1,599,840			891	1,764,180	933	1,847,340	976	1,932,480
767	1,518,660	809	1,601,820	850	1,683,000	892	1,766,160	934	1,849,320	977	1,934,460
768	1,520,640			851	1,684,980	893	1,768,140	935	1,851,300	978	1,936,440
769	1,522,620	810	1,603,800	852	1,686,960	894	1,770,120	936	1,853,280	979	1,938,420
		811	1,605,780	853	1,688,940	895	1,772,100	937	1,855,260		
770	1,524,600	812	1,607,760	854	1,690,920	896	1,774,080	938	1,857,240	980	1,940,400
771	1,526,580	813	1,609,740	855	1,692,900	897	1,776,060	939	1,859,220	981	1,942,380
772	1,528,560	814	1,611,720	856	1,694,880	898	1,778,040			982	1,944,360
773	1,530,540	815	1,613,700	857	1,696,860	899	1,780,020	940	1,861,200	983	1,946,340
774	1,532,520	816	1,615,680	858	1,698,840			941	1,863,180	984	1,948,320
775	1,534,500	817	1,617,660	859	1,700,820	900	1,782,000	942	1,865,160	985	1,950,300
776	1,536,480	818	1,619,640			901	1,783,980	943	1,867,140	986	1,952,280
777	1,538,460	819	1,621,620	860	1,702,800	902	1,785,960	944	1,869,120	987	1,954,260
778	1,540,440			861	1,704,780	903	1,787,940	945	1,871,100	988	1,956,240
779	1,542,420	820	1,623,600	862	1,706,760	904	1,789,920	946	1,873,080	989	1,958,220
		821	1,625,580	863	1,708,740	905	1,791,900	947	1,875,060		
780	1,544,400	822	1,627,560	864	1,710,720	906	1,793,880	948	1,877,040	990	1,960,200
781	1,546,380	823	1,629,540	865	1,712,700	907	1,795,860	949	1,879,020	991	1,962,180
782	1,548,360	824	1,631,520	866	1,714,680	908	1,797,840			992	1,964,160
783	1,550,340	825	1,633,500	867	1,716,660	909	1,799,820	950	1,881,000	993	1,966,140
784	1,552,320	826	1,635,480	868	1,718,640			951	1,882,980	994	1,968,120
785	1,554,300	827	1,637,460	869	1,720,620	910	1,801,800	952	1,884,960	995	1,970,100
786	1,556,280	828	1,639,440			911	1,803,780	953	1,886,940	996	1,972,080
787	1,558,260	829	1,641,420	870	1,722,600	912	1,805,760	954	1,888,920	997	1,974,060
788	1,560,240			871	1,724,580	913	1,807,740	955	1,890,900	998	1,976,040
789	1,562,220	830	1,643,400	872	1,726,560	914	1,809,720	956	1,892,880	999	1,978,020
		831	1,645,380	873	1,728,540	915	1,811,700	957	1,894,860		
790	1,564,200	832	1,647,360	874	1,730,520	916	1,813,680	958	1,896,840	1000	1,980,000
791	1,566,180	833	1,649,340	875	1,732,500	917	1,815,660	959	1,898,820	1001	1,981,980

The following examples illustrate the various uses of this table:

Question: How many Petrograd standards are 990 M feet B. M.?
Answer: 500 Petrograd standards.

Question: How many Petrograd standards are 310,810 board feet?
Answer: 308,880 board feet = 156.000 Petrograd standards.
1,930 board feet = 0.975 Petrograd standards.
310,810 board feet = 156.975 Petrograd standards.

Question: What is the price per Petrograd standard when the price per M feet B. M. is $20?
Answer: $39.60.

Question: What is the price per M feet B. M. when the price per Petrograd standard is $105?
Answer: $104.94 per Petrograd standard = $53.00 per M feet B. M.
.06 per Petrograd standard = .03 per M feet B. M.
105.00 per Petrograd standard = 53.03 per M feet B. M.

TABLE 151

LUMBER PRICE CONVERSION TABLE[1] (SAWN LUMBER AND TIMBER)

Indicating Price Per Thousand Board Feet Compared With Equivalent Price Per Petrograd Standard, Per Cubic Foot, and Per Cubic Meter

M Board Feet	*Petrograd Standard*	*Cubic Foot*	*Cubic Meter*	*M Board Feet*	*Petrograd Standard*	*Cubic Foot*	*Cubic Meter*	*M Board Feet*	*Petrograd Standard*	*Cubic Foot*	*Cubic Meter*
$10.00	$19.80	$0.120	$4.24	$25.00	$49.50	$0.300	$10.60	$40.00	$79.20	$0.480	$16.96
10.25	20.30	.123	4.34	25.25	50.00	.303	10.70	40.25	79.70	.483	17.06
10.50	20.79	.126	4.45	25.50	50.49	.306	10.81	40.50	80.19	.486	17.17
10.75	21.29	.129	4.55	25.75	50.99	.309	10.91	40.75	80.69	.489	17.27
11.00	21.78	.132	4.66	26.00	51.48	.312	11.02	41.00	81.18	.492	17.38
11.25	22.28	.135	4.76	26.25	51.98	.315	11.12	41.25	81.68	.495	17.48
11.50	22.77	.138	4.87	26.50	52.47	.318	11.23	41.50	82.17	.498	17.59
11.75	23.27	.141	4.97	26.75	52.97	.321	11.33	41.75	82.67	.501	17.69
12.00	23.76	.144	5.08	27.00	53.46	.324	11.44	42.00	83.16	.504	17.80
12.25	24.26	.147	5.18	27.25	53.96	.327	11.54	42.25	83.66	.507	17.90
12.50	24.75	.150	5.29	27.50	54.45	.330	11.65	42.50	84.15	.510	18.01
12.75	25.25	.153	5.39	27.75	54.95	.333	11.76	42.75	84.65	.513	18.12
13.00	25.74	.156	5.51	28.00	55.44	.336	11.87	43.00	85.14	.516	18.23
13.25	26.24	.159	5.61	28.25	55.94	.339	11.97	43.25	85.64	.519	18.33
13.50	26.73	.162	5.72	28.50	56.43	.342	12.08	43.50	86.13	.522	18.44
13.75	27.23	.165	5.82	28.75	56.93	.345	12.18	43.75	86.63	.525	18.54
14.00	27.72	.168	5.93	29.00	57.42	.348	12.29	44.00	87.12	.528	18.65
14.25	28.22	.171	6.03	29.25	57.92	.351	12.39	44.25	87.62	.531	18.75
14.50	28.71	.174	6.14	29.50	58.41	.354	12.50	44.50	88.11	.534	18.86
14.75	29.21	.177	6.25	29.75	58.91	.357	12.61	44.75	88.61	.537	18.97
15.00	29.70	.180	6.36	30.00	59.40	.360	12.72	45.00	89.10	.540	19.08
15.25	30.20	.183	6.46	30.25	59.90	.363	12.82	45.25	89.60	.543	19.18
15.50	30.69	.186	6.56	30.50	60.39	.366	12.92	45.50	90.09	.546	19.29
15.75	31.19	.189	6.67	30.75	60.89	.369	13.03	45.75	90.59	.549	19.39
16.00	31.68	.192	6.78	31.00	61.38	.372	13.14	46.00	91.08	.552	19.50
16.25	32.18	.195	6.88	31.25	61.88	.375	13.24	46.25	91.58	.555	19.60
16.50	32.67	.198	6.99	31.50	62.37	.378	13.35	46.50	92.07	.558	19.71
16.75	33.17	.201	7.09	31.75	62.87	.381	13.45	46.75	92.57	.561	19.82
17.00	33.66	.204	7.20	32.00	63.36	.384	13.56	47.00	93.06	.564	19.93
17.25	34.16	.207	7.30	32.25	63.86	.387	13.66	47.25	93.56	.567	20.03
17.50	34.65	.210	7.41	32.50	64.35	.390	13.77	47.50	94.05	.570	20.14
17.75	35.15	.213	7.52	32.75	64.85	.393	13.88	47.75	94.55	.573	20.24
18.00	35.64	.216	7.63	33.00	65.34	.396	13.99	48.00	95.04	.576	20.35
18.25	36.14	.219	7.73	33.25	65.84	.399	14.09	48.25	95.54	.579	20.45
18.50	36.63	.222	7.84	33.50	66.33	.402	14.20	48.50	96.03	.582	20.56
18.75	37.13	.225	7.94	33.75	66.83	.405	14.31	48.75	96.53	.585	20.66
19.00	37.62	.228	8.05	34.00	67.32	.408	14.41	49.00	97.02	.588	20.77
19.25	38.12	.231	8.15	34.25	67.82	.411	14.51	49.25	97.52	.591	20.87
19.50	38.61	.234	8.26	34.50	68.31	.414	14.62	49.50	98.01	.594	20.98
19.75	39.11	.237	8.37	34.75	68.81	.417	14.73	49.75	98.51	.597	21.09
20.00	39.60	.240	8.48	35.00	69.30	.420	14.84	50.00	99.00	.600	21.20
20.25	40.10	.243	8.59	35.25	69.80	.423	14.94	50.25	99.50	.603	21.30
20.50	40.59	.246	8.69	35.50	70.29	.426	15.05	50.50	99.99	.606	21.41
20.75	41.09	.249	8.79	35.75	70.79	.429	15.15	50.75	100.49	.609	21.51
21.00	41.58	.252	8.90	36.00	71.28	.432	15.26	51.00	100.98	.612	21.62
21.25	42.08	.255	9.00	36.25	71.78	.435	15.36	51.25	101.48	.615	21.72
21.50	42.57	.258	9.11	36.50	72.27	.438	15.47	51.50	101.97	.618	21.83
21.75	43.07	.261	9.21	36.75	72.77	.441	15.57	51.75	102.47	.621	21.93
22.00	43.56	.264	9.32	37.00	73.26	.444	15.68	52.00	102.96	.624	22.04
22.25	44.06	.267	9.42	37.25	73.76	.447	15.78	52.25	103.46	.627	22.14
22.50	44.55	.270	9.53	37.50	74.25	.450	15.89	52.50	103.95	.630	22.25
22.75	45.05	.273	9.64	37.75	74.75	.453	15.99	52.75	104.45	.633	22.36
23.00	45.54	.276	9.75	38.00	75.24	.456	16.11	53.00	104.94	.636	22.47
23.25	46.04	.279	9.85	38.25	75.74	.459	16.21	53.25	105.44	.639	22.57
23.50	46.53	.282	9.96	38.50	76.23	.462	16.32	53.50	105.93	.642	22.68
23.75	47.03	.285	10.06	38.75	76.73	.465	16.42	53.75	106.43	.645	22.78
24.00	47.52	.288	10.17	39.00	77.22	.468	16.53	54.00	106.92	.648	22.89
24.25	48.02	.291	10.27	39.25	77.72	.471	16.63	54.25	107.42	.651	22.99
24.50	48.51	.294	10.38	39.50	78.21	.474	16.74	54.50	107.91	.654	23.10
24.75	49.01	.297	10.49	39.75	78.71	.477	16.85	54.75	108.41	.657	23.21

[1] Issued by the Lumber Division of the Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C.

TABLE 151—*Continued*

M Board Feet	*Petrograd Standard*	*Cubic Foot*	*Cubic Meter*	*M Board Feet*	*Petrograd Standard*	*Cubic Foot*	*Cubic Meter*	*M Board Feet*	*Petrograd Standard*	*Cubic Foot*	*Cubic Meter*
$55.00	$108.90	$0.660	$23.32	$70.00	$138.60	$0.840	$29.68	$85.00	$168.30	$1.020	$36.04
55.25	109.40	.663	23.42	70.25	139.10	.843	29.78	85.25	168.80	1.023	36.15
55.50	109.89	.666	23.53	70.50	139.59	.846	29.89	85.50	169.29	1.026	36.25
55.75	110.39	.669	23.63	70.75	140.09	.849	29.99	85.75	169.79	1.029	36.36
56.00	110 88	.672	23.74	71.00	140.58	.852	30.10	86.00	170.28	1.032	36.46
56.25	111.38	.675	23.84	71.25	141.08	.855	30.20	86.25	170.78	1.035	36.56
56.50	111.87	.678	23.95	71.50	141.57	.858	30.31	86.50	171.27	1.038	36.67
56.75	112.37	.681	24.05	71.75	142.07	.861	30.42	86.75	171.77	1.041	36.78
57.00	112.86	.684	24.16	72.00	142.56	.864	30.52	87.00	172.26	1.044	36.88
57.25	113.36	.687	24.26	72.25	143.06	.867	30.63	87.25	172.76	1.047	36.98
57.50	113.85	.690	24.37	72.50	143.55	.870	30.74	87.50	173.25	1.050	37.09
57.75	114.35	.693	24.48	72.75	144.05	.873	30.84	87.75	173.75	1.053	37.20
58.00	114.84	.696	24.59	73.00	144.54	.876	30.95	88.00	174.24	1.056	37.31
58.25	115.34	.699	24.69	73.25	145.04	.879	31.05	88.25	174.74	1.059	37.41
58.50	115.83	.702	24.80	73.50	145.53	.882	31.16	88.50	175.23	1.062	37.52
58.75	116.33	.705	24.90	73.75	146.03	.885	31.26	88.75	175.73	1.065	37.62
59.00	116.82	.708	25.01	74.00	146.52	.888	31.37	89.00	176.22	1.068	37.73
59.25	117.32	.711	25.11	74.25	147.02	.891	31.47	89.25	176.72	1.071	37.83
59.50	117.81	.714	25.22	74.50	147.51	.894	31.58	89.50	177.21	1.074	37.94
59.75	118.31	.717	25.33	74.75	148.01	.897	31.69	89.75	177.71	1.077	38.05
60.00	118.80	.720	25.44	75.00	148.50	.900	31.80	90.00	178.20	1.080	38.16
60.25	119.30	.723	25.54	75.25	149.00	.903	31.90	90.25	178.70	1.083	38.26
60.50	119.79	.726	25.65	75.50	149.49	.906	32.01	90.50	179.19	1.086	38.37
60.75	120.29	.729	25.75	75.75	149.99	.909	32.11	90.75	179.69	1.089	38.47
61.00	120.78	.732	25.86	76.00	150.48	.912	32.22	91.00	180.18	1.092	38.58
61.25	121.28	.735	25.96	76.25	150.98	.915	32.33	91.25	180.68	1.095	38.68
61.50	121.77	.738	26.07	76.50	151.47	.918	32.43	91.50	181.17	1.098	38.79
61.75	122.27	.741	26.17	76.75	151.97	.921	32.53	91.75	181.67	1.101	38.89
62.00	122.76	.744	26.28	77.00	152.46	.924	32.64	92.00	182.16	1.104	39.00
62.25	123.26	.747	26.39	77.25	152.96	.927	32.74	92.25	182.66	1.107	39.10
62.50	123.75	.750	26.49	77.50	153.45	.930	32.85	92.50	183.15	1.110	39.21
62.75	124.25	.753	26.60	77.75	153.95	.933	32.96	92.75	183.65	1.113	39.32
63.00	124.74	.756	26.71	78.00	154.44	.936	33.07	93.00	184.14	1.116	39.43
63.25	125.24	.759	26.81	78.25	154.94	.939	33.17	93.25	184.64	1.119	39.53
63.50	125.73	.762	26.92	78.50	155.43	.942	33.28	93.50	185.13	1.122	39.64
63.75	126.23	.765	27.02	78.75	155.93	.945	33.38	93.75	185.63	1.125	39.75
64.00	126.72	.768	27.13	79.00	156.42	.948	33.49	94.00	186.12	1.128	39.85
64.25	127.22	.771	27.23	79.25	156.92	.951	33.60	94.25	186.62	1.131	39.95
64.50	127.71	.774	27.34	79.50	157.41	.954	33.70	94.50	187.11	1.134	40.06
64.75	128.21	.777	27.45	79.75	157.91	.957	33.81	94.75	187.61	1.137	40.17
65.00	128.70	.780	27.56	80.00	158.40	.960	33.92	95.00	188.10	1.140	40.28
65.25	129.20	.783	27.66	80.25	158.90	.963	34.02	95.25	188.60	1.143	40.38
65.50	129.69	.786	27.77	80.50	159.39	.966	34.13	95.50	189.09	1.146	40.49
65.75	130.19	.789	27.87	80.75	159.89	.969	34.23	95.75	189.59	1.149	40.60
66.00	130.68	.792	27.98	81.00	160.38	.972	34.34	96.00	190.08	1.152	40.70
66.25	131.18	.795	28.08	81.25	160.88	.975	34.44	96.25	190.58	1.155	40.80
66.50	131.67	.798	28.19	81.50	161.37	.978	34.55	96.50	191.07	1.158	40.91
66.75	132.17	.801	28.29	81.75	161.87	.981	34.65	96.75	191.57	1.161	41.01
67.00	132.66	.804	28.40	82.00	162.36	.984	34.76	97.00	192.06	1.164	41.12
67.25	133.16	.807	28.50	82.25	162.86	.987	34.86	97.25	192.56	1.167	41.22
67.50	133.65	.810	28.61	82.50	163.35	.990	34.97	97.50	193.05	1.170	41.33
67.75	134.15	.813	28.72	82.75	163.85	.993	35.08	97.75	193.55	1.173	41.44
68.00	134.64	.816	28.83	83.00	164.34	.996	35.19	98.00	194.04	1.176	41.55
68.25	135.14	.819	28.93	83.25	164.84	.999	35.29	98.25	194.54	1.179	41.65
68.50	135.63	.822	29.04	83.50	165.33	1.002	35.40	98.50	195.03	1.182	41.76
68.75	136.13	.825	29.14	83.75	165.83	1.005	35.50	98.75	195.53	1.185	41.87
69.00	136.62	.828	29.25	84.00	166,32	1.008	35.61	99.00	196.02	1.188	41.97
69.25	137.12	.831	29.35	84.25	166.82	1.011	35.71	99.25	196.52	1.191	42.07
69.50	137.61	.834	29.46	84.50	167.31	1.014	35.82	99.50	197.01	1.194	42.18
69.75	138.11	.837	29.57	84.75	167.81	1.017	35.93	99.75	197.51	1.197	42.29

The following example illustrates the various uses of this table:

Question. What is the price (*a*) per Petrograd standard, (*b*) per cubic foot, (*c*) per cubic meter, of lumber, if the price per thousand board feet is $10.00.

Answer. (*a*) $19.80, (*b*) $0.12, (*c*) $4.24.

1 Petrograd standard = 1,980 board feet of sawn lumber or timber.

1 cubic meter = 424 board feet of sawn lumber or timber.

TABLE 152

THICKNESS FACTORS FOR VENEER

Giving: (1) Veneer thickness for the same total bending strength as birch (K_s); (2) veneer thickness for the same weight as birch (K_w.)

Species	*D Average Specific Gravity of Species*[11] *Based on Oven-dry Weight and Air-dry Volume*	*Specific Gravity of Glued Plywood as Tested, based on Oven-dry Weight and Volume at Test*	*Moisture Content of Plywood as Tested Per Cent*	*S Unit Bending Strength Compared with Birch*[1] *Per Cent*	*K_s Thickness Factor for the Same Total Bending Strength as Birch* $\sqrt{\frac{100}{S}}$	*K_w Thickness Factor for the Same Weight as Birch* $\frac{0.63}{D}$
Ash, black	0.50	0.49	9.1	52	1.39	1.26
Ash, commercial white	0.58	0.60	10.2	72	1.18	1.09
Basswood	0.38	0.42	9.2	48	1.44	1.66
Beech	0.63	0.67	8.6	94	1.03	1.00
Birch, yellow	0.63	0.67	8.5	100	1.00	1.00
Cedar, Spanish	0.34	0.41	13.3	43	1.52	1.85
Cherry[2]	0.51	0.56	9.1	80	1.12	1.24
Chestnut	0.44	0.43	11.7	34	1.72	1.43
Cottonwood	0.43	0.46	8.8	56	1.34	1.47
Cypress, bald	0.44	0.45	8.0	57	1.32	1.43
Douglas fir[3]	0.51	0.48	8.6	60	1.29	1.24
Elm, cork	0.66	0.62	9.4	78	1.13	0.95
Elm, white	0.51	0.52	8.9	58	1.13	1.24
Fir, true[4]	0.38	0.40	8.5	57	1.32	1.66
Gum[5]	0.52	0.54	10.6	55	1.35	1.21
Gum, cotton	0.52	0.50	10.3	49	1.43	1.21
Gum, red	0.49	0.54	8.7	64	1.25	1.29
Hackberry	0.54	0.54	10.2	55	1.35	1.17
Hemlock, western	0.42	0.47	9.7	60	1.29	1.50
Magnolia[6]	0.51	0.58	8.8	74	1.16	1.24
Mahogany, African[7]	0.46	0.52	12.7	56	1.34	1.37
Mahogany, Philippine[8]	0.57	0.53	10.7	68	1.21	1.10
Mahogany, true	0.49	0.48	11.4	57	1.32	1.29
Maple, soft[9]	0.48	0.57	8.9	74	1.16	1.31
Maple, hard[10]	0.62	0.68	8.0	100	1.00	1.02
Oak, commercial red	0.63	0.59	9.3	59	1.30	1.00
Oak, commercial white	0.69	0.64	9.5	69	1.20	0.91
Pine, sugar	0.37	0.42	9.4	51	1.40	1.70
Pine, white	0.39	0.42	5.4	64	1.25	1.61
Poplar, yellow	0.41	0.50	9.4	58	1.31	1.54
Redwood	0.36[12]	0.42	9.7	50	1.41	1.75
Sycamore	0.50	0.56	9.2	71	1.19	1.26
Spruce	0.38	0.42	8.3	50	1.41	1.66
Walnut, black	0.57	0.59	9.1	83	1.10	1.10
Yucca species	....	0.49	7.3	23	2.09	....

[1] Average of the column bending moduli parallel and perpendicular to grain compared to birch, based on tests of 3-ply wood, each ply one-third of the total panel thickness.

[2] Probably black cherry.

[3] Coast type.

[4] Probably white fir.

[5] Probably black gum.

[6] Probably (evergreen) magnolia.

[7] Probably Khaya species.

[8] Probably tanguile.

[9] Probably silver maple.

[10] Probably sugar or black maple.

[11] Values of domestic species taken from U. S. Department of Agriculture Bulletin 556, Mechanical Properties of Woods Grown in the United States.

[12] Based on tests not included in Bulletin 556.

TABLE 153

TENSILE STRENGTH OF PLYWOOD AND VENEER

Species	*Number of Tests* (*a*)	*Moisture Content at Test Per Cent* (*b*)	*Specific Gravity*[1] *of Plywood* (*c*)	*Tensile Strength*[2] *of 3-ply wood Parallel to Grain of Faces, Lb. Per Sq. In.* (*d*)	*Tensile Strength*[3] *of Single Ply Veneer ½ (d), Lb. Per Sq. M.* (*e*)
Ash, black	120	9.1	0.49	6,180	9,270
Ash, commercial white	200	10.2	0.60	6,510	9,760
Basswood	200	9.2	0.42	6,880	10,320
Beech	120	8.6	0.67	13,000	19,500
Birch, yellow	200	8.5	0.67	13,210	19,820
Cedar, Spanish	115	13.3	0.41	5,200	7,800
Cherry[4]	115	9.1	0.56	8,460	12,690
Chestnut	40	11.7	0.43	4,430	6,640
Cottonwood[5]	120	8.8	0.46	7,280	10,920
Cypress, bald	113	8.0	0.45	6,160	9,240
Douglas fir[6]	200	8.6	0.48	6,180	9,270
Elm, cork	65	9.4	0.62	8,440	12,660
Elm, white	160	8.9	0.52	5,860	8,790
Fir, true[7]	24	8.5	0.40	5,670	8,510
Gum[8]	35	10.6	0.54	6,960	10,440
Gum, cotton	80	10.3	0.50	6,260	9,300
Gum, red	182	8.7	0.54	7,850	11,780
Hackberry	80	10.2	0.54	6,920	10,380
Hemlock, western	119	9.7	0.47	6,800	10,200
Magnolia[9]	80	8.8	0.58	9,220	13,830
Mahogany, African [10]	20	12.7	0.52	5,370	8,060
Mahogany, Philippine[11]	25	10.7	0.53	10,670	16,000
Mahogany, true	35	11.4	0.48	6,390	9,580
Maple, soft[12]	120	8.9	0.57	8,180	12,270
Maple, hard[13]	192	8.0	0.68	10,190	15,290
Oak, commercial red	115	9.3	0.59	5,480	8,220
Oak, commercial white	195	9.5	0.64	6,730	10,100
Pine, sugar	110	8.0	0.42	5,530	8,300
Pine, white	40	5.4	0.42	5,720	8,580
Poplar, yellow	155	9.4	0.50	7,390	11,080
Redwood	105	9.7	0.42	4,770	7,160
Spruce, Sitka	121	8.3	0.42	5,650	8,480
Sycamore	163	9.2	0.56	8,030	12,040
Walnut, black	110	9.1	0.59	8,250	12,380
Yucca species	33	7.3	0.49	2,210	3,320

[1] Specific gravity based on oven-dry weight and volume at test.

[2] Based on total cross-sectional area.

[3] Based on assumption that center ply carries no load.

[4] Probably black cherry.

[5] Probably (common) cottonwood.

[6] Coast type.

[7] Probably white fir.

[8] Probably black gum.

[9] Probably (evergreen) magnolia.

[10] Probably Khaya species.

[11] Probably tanguile.

[12] Probably silver maple.

[13] Sugar or black.

Data based on tests of 3-ply panels with all plies in any one panel same thickness and species.

TABLE 154

Strength of Various Species of 3-Ply Panels

(All plies in any one panel were of the same thickness and of the same species—grain of successive plies at right angles. In most cases eight thicknesses of plywood ranging from 3/30 in. to 3/6 in. were tested.)

Species	Average Specific Gravity of Plywood Based on Oven-dry Weight and Volume at Test	Average Moisture Per Cent	Column Bending						Tensile Test				Splitting Resistance	
			Column-bending Modulus				Modulus of Elasticity		Parallel[1]		Perpendicular[1]			
			Parallel[1]		Perpendicular[1]		Parallel[1]	Perpendicular[1]						
			No. of Tests	Lb. Per Sq. In.	No. of Tests	Lb. Per Sq. In.	1000 Lb. Per Sq. In.	1000 Lb. Per Sq. In.	No. of Tests	Lb. Per Sq. In.	No. of Tests	Lb. Per Sq. In.	No. of Tests	Per Cent of Birch
Ash, black	0.49	9.1	120	7,760	120	1770	1070	96	120	6,180	120	3940	240	3
Ash, commercial white	0.60	10.2	200	9,930	200	2620	1420	143	200	6,510	200	4350	400	71
Basswood	0.42	9.2	200	7,120	200	1670	1210	85	200	6,880	200	4300	400	63
Beech	0.67	8.6	120	15,390	120	2950	2150	167	120	13,000	120	7290	240	94
Birch, yellow	0.67	8.5	195	16,000	200	3200	2260	197	200	13,210	200	7700	400	100
Cedar, Spanish	0.41	13.3	115	6,460	115	1480	1030	84	115	5,200	115	3340	230	60
Cherry[3]	0.56	9.1	115	12,260	115	2620	1630	152	115	8,460	115	5920	230	80
Chestnut	0.43	11.7	40	5,160	40	1110	740	75	40	4,430	40	2600	80	74
Cottonwood[4]	0.46	8.8	120	8,460	120	1870	1440	109	120	7,280	120	4240	240	85
Cypress, bald	0.45	8.0	113	8,890	113	1850	1220	95	113	6,160	113	3980	148	49
Douglas fir[5]	0.48	8.6	176	9,340	200	1940	1530	126	200	6,188	200	3910	374	63
Elm, cork	0.62	9.4	65	12,710	65	2500	1980	136	65	8,440	65	5500	130	99
Elm, white	0.52	8.9	160	8,680	160	1970	1220	109	160	5,860	160	3990	320	75
Fir, true[6]	0.40	8.5	24	9,200	24	1811	1580	100	24	5,670	24	3770	48	60
Gum[7]	0.54	10.6	40	8,090	40	1920	1280	113	35	6,960	35	4320	70	55
Gum, cotton	0.50	10.3	80	7,760	80	1580	1300	111	80	6,260	80	3760	160	60
Gum, red	0.54	8.7	182	9,970	182	2070	1590	120	182	7,850	182	4930	364	80
Hackberry	0.54	10.2	80	8,100	80	1880	1150	99	80	6,920	80	4020	160	84
Hemlock, western	0.47	9.7	119	9,250	119	1960	1580	112	119	6,800	119	4580	238	63
Magnolia[8]	0.58	8.8	80	10,830	80	2600	1700	138	80	9,220	80	5730	120	85
Mahogany, African[9]	0.52	12.7	20	8,070	20	2000	1260	144	20	5,370	20	3770	...	...
Mahogany, Philippine[10]	0.53	10.7	25	10,160	25	2310	1820	169	25	10,670	25	5990	50	90
Mahogany, true	0.48	11.4	35	8,500	35	1940	1250	117	35	6,390	35	3780	...	...
Maple, soft[11]	0.57	8.9	120	11,540	120	2420	1750	145	120	8,180	120	5380	240	106
Maple, hard [12]	0.68	8.0	202	15,600	202	3340	2110	189	192	10,190	202	6530	404	114
Oak, commercial red	0.59	9.3	115	8,500	115	2070	1290	120	115	5,480	115	3610	230	70
Oak, commercial white	0.64	9.5	195	10,490	195	2310	1340	118	195	6,730	195	4200	390	85
Pine, sugar	0.42	9.4	65	8,050	70	1670	1310	90	70	5,430	70	3690	140	47
Pine, white	0.42	5.4	40	10,130	40	2050	1570	111	40	5,720	40	3340	80	31
Poplar, yellow	0.50	9.4	165	8,860	165	1920	1540	115	155	7,390	165	4720	330	51
Redwood	0.42	9.7	105	8,230	105	1550	1180	108	105	4,770	105	2960	210	48
Spruce, Sitka	0.42	8.3	121	7,710	121	1690	1370	105	121	5,650	121	3410	224	78
Sycamore	0.56	9.2	163	11,040	163	2340	1630	130	163	8,030	163	5220	326	77
Walnut, black	0.59	9.1	110	12,660	110	2770	1740	141	110	8,250	110	5260	220	77
Yucca species	0.49	7.3	33	2,960	33	900	560	44	33	2,210	33	1700	66	14

[1] Parallel and perpendicular refer to the direction of the grain of the faces relative to the direction of the application of the force.

[2] The relative splitting resistance of the various panels tested depends largely on the holding strength of glue.

[3] Probably black cherry.

[4] Probably (common) cottonwood.

[5] Coast type.

[6] Probably white fir.

[7] Probably black gum.

[8] Probably (evergreen) magnolia.

[9] Probably Khaya species.

[10] Probably tanguile.

[11] Probably silver maple.

[12] Sugar or black maple.

Note.—In some of the species listed above the tests are rather limited in number. Since there is considerable variation in the strength of wood further tests on additional material would be expected to modify the values appreciably in some cases.

TABLE 155

DRY LOCATIONS

SAFE LOADS IN POUNDS PER SQUARE INCH OF CROSS-SECTIONAL AREA OF SQUARE AND RECTANGULAR TIMBER COLUMNS,

Safe load in pounds per square inch of cross-sectional area of square and rectangular columns used in *dry locations*. This condition of use applies where material is used in interior dry structures such as inclosed buildings, roofs, roof trusses and temporary falsework, either interior or exterior. For other conditions of use see other tables.

SPECIES OF LUMBER[2]	GRADES[2]	RATIO OF LENGTH TO LEAST DIMENSIONS (L/d)[1]										
		10 & less Lbs.	*L/d 12* Lbs.	*L/d 14* Lbs.	*L/d 16* Lbs.	*L/d 18* Lbs.	*L/d 20* Lbs.	*L/d 25* Lbs.	*L/d 30* Lbs.	*L/d 35* Lbs.	*L/d 40* Lbs.	*L/d 50* Lbs.
Cedar, Alaska	Select	800	786	774	753	726	688	526	365	268	206	132
	Common	640	632	627	617	602	582	500				
Cedar, northern and southern white	Select	550	540	530	516	496	468	351	244	179	137	88
	Common	440	435	430	423	412	398	338				
Cedar, Port Orford	Select	890	879	861	834	796	741	526	365	268	206	132
	Common	715	709	700	686	667	639	521				
Cedar, western red	Select	700	686	674	656	629	592	438	304	224	171	110
	Common	560	553	547	538	524	505	425				
Cypress, southern	Select	1100	1063	1030	981	909	810		365	268	206	132
	Common	880	861	843	818	781	729	526				
Douglas fir, Coast region	Dense super-structural	1466	1416	1373	1307	1215	1097					
	Super-structural and dense structural	1300	1264	1235	1189	1123	1027	702	487	358	274	175
	Structural	1200	1176	1152	1112	1059	986					
	Common structural	1100	1097	1060	1032	992	937					
Douglas fir, Inland Empire	Dense super-structural	1466	1416	1373	1307	1215	1079	702	487	358	274	175
	Dense structural	1300	1264	1235	1189	1123	1027					
	No. 1 common dimension and timbers	1010	982	966	943	907	860	625	457	336	257	164
Douglas fir, Rocky Mt. region	Select	800	786	774	753	726	688	526	365	268	206	132
	Common	640	632	627	617	602	582	500				
Fir, balsam	Select	700	686	674	656	629	592	438	304	224	171	110
	Common	560	553	547	538	524	505	425				
Fir, commercial white	Select	700	689	678	664	641	611	482	335	246	188	121
	Common	560	554	549	542	530	515	449				
Hemlock, eastern	Select	700	689	678	664	641	611	482	335	246	188	121
	Common	560	554	549	542	530	515	449				
Hemlock, West Coast	Select	900	885	872	852	823	783	614	426	313	240	153
	Common	720	712	706	696	680	660	573				
Larch, western	No. 1 common dimension and timbers	1010	984	964	933	885	818	566	396	291	223	142
Pine, Calif., Idaho, and northern white, lodgepole, Pondosa, sugar	Select	750	733	718	695	663	617	438	304	224	171	110
	Common	600	591	583	572	556	532	434				
Pine, Norway	Select	800	786	774	753	726	688	526	365	268	206	132
	Common	640	632	627	617	602	582	500				
Pine, southern yellow	Extra dense heart	1450	1400	1355	1300	1195	1065	701				
	Dense heart	1300	1265	1235	1190	1125	1027	701				
	Square edge and sound	1200	1174	1150	1110	1062	984	701	487	358	274	175
	No. 1 common	1000	984	970	950	920	880	700				
Redwood	Super-structural	1422	1339	1272	1165	1023	822					
	Prime structural	1245	1189	1142	1073	971	822					
	Select structural	1100	1063	1029	979	907	807	526	365	268	206	132
	Heart structural	1000	972	947	910	858	782					
Spruce, Englemann	Select	600	586	574	556	530	494	351	244	179	137	88
	Common	480	473	466	457	444	426	347				
Spruce, red, white, Sitka	Select	800	786	774	753	726	688	526	365	268	206	132
	Common	640	632	627	617	602	582	500				
Tamarack, eastern	Select	1000	976	955	923	877	817	570	396	291	223	142
	Common	800	788	777	761	737	706	566				

[1] For columns with L/d intermediate between those which are given in this table, the safe load in pounds per square inch may be determined by interpolation.

No columns shall be used with greater unsupported length than 50 times its least diameter.

[2] Working stresses for grades and species shown above are based upon recommendations from lumber manufacturers' associations whose members produce the respective species.

TABLE 156

LOCATIONS OCCASIONALLY WET

SAFE LOADS IN POUNDS PER SQUARE INCH OF CROSS-SECTIONAL AREA OF SQUARE AND RECTANGULAR TIMBER COLUMNS

Safe load in pounds per square inch of cross-sectional area of square and rectangular timber columns used in *locations occasionally wet but quickly dried.* This condition of use applies to exterior structures such as bridges, trestles, grandstands or bleachers and open sheds. For other conditions of use see other tables.

SPECIES OF LUMBER [2]	GRADES [2]	RATIO OF LENGTH TO LEAST DIMENSIONS (L/d) [1]										
		10 & less Lbs.	*L/d 12* Lbs.	*L/d 14* Lbs.	*L/d 16* Lbs.	*L/d 18* Lbs.	*L/d 20* Lbs.	*L/d 25* Lbs.	*L/d 30* Lbs.	*L/d 35* Lbs.	*L/d 40* Lbs.	*L/d 50* Lbs.
Cedar, Alaska	Select	744	738	728	712	689	657	523	365	268	206	132
	Common	597	594	588	581	569	552	485				
Cedar, northern and southern white	Select	496	492	485	474	459	438	348	244	179	137	88
	Common	398	396	392	387	379	368	323				
Cedar, Port Orford	Select	818	808	795	774	744	702	526	365	268	206	132
	Common	656	652	645	634	618	597	506				
Cedar, western red	Select	693	686	674	656	629	592	438	304	224	171	110
	Common	557	553	547	538	524	505	425				
Cypress, southern	Select	986	972	947	910	856	781	526	365	268	206	132
	Common	793	786	773	754	726	688					
Douglas fir, Coast region	Dense super-structural	1333	1295	1263	1214	1141	1041	702	487	358	274	175
	Super-structural and dense structural	1200	1176	1152	1112	1059	986	702				
	Structural	1100	1079	1060	1032	992	937	702				
	Com. structural	1000	984	971	950	920	877	700				
Douglas fir, Inland Empire	Dense super-str.	1333	1295	1263	1254	1141	1041	702	487	358	274	175
	Dense struct.	1200	1176	1152	1112	1059	986	702				
	No. 1 common dimension and timbers	830	819	810	796	776	748	531	457	336	257	164
Douglas fir, Rocky Mt. type	Select	793	786	774	753	726	688	526	365	268	206	132
	Common	636	632	627	617	602	582	500				
Fir, balsam	Select	596	591	583	572	556	532	434	304	224	171	110
	Common	478	476	472	466	457	445	395				
Fir, commercial white	Select	694	689	678	664	641	611	482	335	246	188	121
	Common	557	554	549	542	530	515	449				
Hemlock, eastern	Select	694	689	678	664	641	611	482	335	246	188	121
	Common	557	554	549	542	530	515	449				
Hemlock, West Coast	Select	893	885	872	852	823	783	614	426	313	240	153
	Common	716	712	706	696	680	660	573				
Larch, western	No. 1 common	830	816	805	786	759	723	568	396	291	223	142
Pine, California, Idaho and northern white, Pondosa and sugar	Select	742	733	718	695	663	617	438	304	224	171	110
	Common	596	591	583	572	556	532	434				
Pine, Norway	Select	793	786	774	753	726	688	526	365	268	206	132
	Common	636	632	627	617	602	582	500				
Pine, southern yellow	Extra dense heart	1300	1265	1235	1190	1125	1027	701	487	358	274	175
	Dense heart	1150	1127	1104	1070	1024	966	701				
	Str. sq. edge and sound	1050	1029	1019	987	955	903	703				
	No. 1 common	900	888	878	862	842	810	675				
Redwood	Super-structural	1280	1221	1169	1094	979	822		526	365	268	206	132
	Prime structural	1120	1080	1046	993	912	806					
	Select structural	990	963	938	903	851	778					
	Heart structural	900	879	861	843	796	739					
Spruce, Englemann	Select	545	540	530	516	496	468	351	244	179	137	88
	Common	437	435	430	423	412	398	338				
Spruce, red, white, and Sitka	Select	744	738	728	712	689	657	523	365	268	206	132
	Common	597	594	588	581	569	552	485				
Tamarack, eastern	Select	892	882	868	844	811	765	570	396	291	223	142
	Common	716	711	703	691	674	650	548				

[1] For columns with L/d intermediate between those which are given in this table, the safe load in pounds per square inch may be determined by interpolation.

No column shall be used with greater unsupported length than 50 times its least diameter.

[2] Working stresses for grades and species shown above are based upon recommendations from lumber manufacturers' associations whose members produce the respective species.

TABLE 157

LOCATIONS USUALLY WET

SAFE LOADS IN POUNDS PER SQUARE INCH OF CROSS-SECTIONAL AREA OF SQUARE AND RECTANGULAR TIMBER COLUMNS

Safe load in pounds per square inch of cross-sectional area of square and rectangular columns used in *locations usually wet*. This condition of use applies where material is exposed to waves of tide water or in contact with earth or where it is more or less continuously damp or wet. For other conditions of use see other tables.

SPECIES OF LUMBER[2]	GRADES[2]	RATIO OF LENGTH TO LEAST DIMENSIONS (L/d)[1]										
		10 & less Lbs.	*L/d 12* Lbs.	*L/d 14* Lbs.	*L/d 16* Lbs.	*L/d 18* Lbs.	*L/d 20* Lbs.	*L/d 25* Lbs.	*L/d 30* Lbs.	*L/d 35* Lbs.	*L/d 40* Lbs.	*L/d 50* Lbs.
Cedar, Alaska	Select	646	642	636	625	611	590	504	365	268	206	132
	Common	518	516	513	507	500	489	444	364			
Cedar, northern and southern white	Select	447	444	439	432	420	405	340	244	179	137	88
	Common	358	357	354	351	345	337	304	243			
Cedar, Port Orford	Select	744	738	728	712	689	657	523	365	268	206	132
	Common	597	594	588	581	569	552	485				
Cedar, western red	Select	645	639	629	614	593	564	439	304	224	171	110
	Common	517	514	510	502	491	476	412				
Cypress, southern	Select	793	786	774	753	726	688	526	365	268	206	132
	Common	636	632	627	617	602	582	500				
Douglas fir, Coast region	Dense structural	1133	1110	1087	1059	1015	954	702	487	358	274	175
	Super-struct. and dense structural	1000	984	971	950	920	877	700				
	Structural	933	920	909	891	867	833	689				
	Common structural	850	840	832	819	800	774	665				
Douglas fir, Inland Empire	Dense structural	1133	1110	1087	1059	1015	954	702	487	358	274	175
	Dense structural	1000	984	971	950	920	877	700				
	No. 1 common dimension and timbers	655	651	645	638	628	615	561	453	336	257	164
Douglas fir, Rocky Mt. type	Select	695	690	682	669	651	625	518	365	268	206	132
	Common	558	555	551	544	535	521	466				
Fir, balsam	Select	498	495	490	484	474	460	404	304	224	171	110
	Common	399	397	395	392	387	380	351	298			
Fir, commercial white	Select	596	593	587	577	563	544	463	335	246	188	121
	Common	478	476	473	468	461	451	409	334			
Hemlock, eastern	Select	596	593	587	577	563	544	463	335	246	188	121
	Common	478	476	473	468	461	451	409	334			
Hemlock, West Coast	Select	795	790	780	766	746	718	598	426	313	240	153
	Common	637	634	630	623	612	598	537				
Larch, western	No. 1 common dimension and timbers	655	648	641	633	620	602	528	396	291	223	142
Pine, California, Idaho and northern white, Pondosa and sugar	Select	645	639	629	614	593	564	439	304	224	171	110
	Common	517	514	510	502	491	476	412				
Pine, Norway	Select	695	690	682	669	651	625	518	365	268	206	132
	Common	558	555	551	544	535	521	466				
Pine, southern yellow	Extra dense heart	1100	1078	1060	1034	990	935	701	487	358	274	175
	Dense heart	1000	984	970	950	920	880	700				
	Structural, sq. edge and sound	950	940	921	902	874	845	684				
	No. 1 common	800	792	785	774	758	737	650				
Redwood	Super-structural	1067	1030	1002	958	893	804	526	365	268	206	132
	Prime structural	933	909	891	861	806	754					
	Select structural	825	808	796	772	744	701					
	Heart structural	750	738	727	711	687	657					
Spruce, Englemann	Select	447	444	439	432	420	405	340	244	179	137	88
	Common	358	357	354	351	345	337	304	243			
Spruce, red, white and Sitka	Select	646	642	636	625	611	590	504	365	268	206	132
	Common	518	516	513	507	500	489	444	364			
Tamarack, eastern	Select	794	788	777	761	737	706	566	396	291	223	142
	Common	637	634	628	620	608	591	520				

[1] For Columns with L/d intermediate between those which are given in this table, the safe load in pounds per square inch may be determined by interpolation.

No column shall be used with greater unsupported length than 50 times its least diameter.

[2] Working stresses for grades and species shown above are based upon recommendations from lumber manufacturers associations whose members produce the respective species.

TABLE 158

ALLOWABLE UNIT STRESSES FOR STRUCTURAL LUMBER AND TIMBERS

DRY LOCATIONS

Applies to use in interior dry structures, such as inclosed buildings, roofs, roof trusses and temporary falsework, either interior or exterior

SPECIES OF TIMBER[1]	GRADES[1]	ALLOWABLE UNIT STRESS IN POUNDS PER SQUARE INCH					
		Extreme Fiber in Bending		*Maximum Horizontal Shear*	*Compression*		*Modulus of Elasticity*
		Joists & Plank Sizes; 4" and Less in Thickness	*Beams & Stringer Sizes; 5" and Thicker*		*Parallel to Grain (Short Columns)*	*Perpendicular to Grain*	
Cedar, Alaska	Select	1100	1100	90	800	250	1,200,000
	Common	880	880	72	640		
Cedar, northern and southern white	Select	750	750	70	550	175	800,000
	Common	600	600	56	440		
Cedar, Port Orford	Select	1100	1100	90	900	250	1,200,000
	Common	880	880	72	720		
Cedar, western red	Select	900	900	80	700	200	1,000,000
	Common	720	720	64	560		
Cypress, southern	Select	1300	1300	100	1100	350	1,200,000
	Common	1040	1040	80	880		
Douglas fir, Coast region	Dense super-structural	2000	2000	120	1466	380	
	Super-structural and dense structural	1800	1800	105	1300	345	1,600,000
	Structural	1600	1600	90	1200	345	
	Common structural	1400	1400	84	1100	325	
Douglas fir, Inland Empire	Dense super-structural	2000	2000	120	1466	380	
	Dense structural.	1800	1800	105	1300	345	1,600,000
	No. 1 common dimension and timbers	1135	1135	70	1010	315	1,500,000
Douglas fir, Rocky Mt. region	Select	1100	1100	85	800	275	1,200,000
	Common	880	880	68	640		
Fir, balsam	Select	900	900	70	700	150	1,000,000
	Common	720	720	56	560	150	
Fir, golden, Nobel, silver white (commercial white)	Select	1000	1000	70	700	300	1,100,000
	Common	880	880	56	560		
Hemlock, eastern	Select	1100	1100	70	700	300	1,100,000
	Common	880	880	56	560		
Hemlock, West Coast	Select	1300	1300	75	900	300	1,400,000
	Common	1040	1040	60	720		
Larch, Western	No. 1 common dimension and timbers	1135	1135	70	1010	325	1,300,000
Pine, California, Idaho and northern white, lodgepole, Pondosa, sugar	Select	900	900	85	750	250	1,000,000
	Common	720	720	68	600		
Pine, Norway	Select	1100	1100	85	800	300	1,200,000
	Common	880	880	68	640		
Pine, southern yellow	Extra dense select, structural	2300	2300	200	1600	475	
	Select structural	2000	2000	175	1450	375	
	Extra dense heart	2000	2000	175	1450	475	1,600,000
	Dense heart	1800	1800	150	1300	375	
	Struct. square edge and sound	1600	1600	125	1200	375	
	No. 1 common	1200	1200	100	1000	325	
Redwood	Super-structural	2133	1707	93	1422	276	
	Prime structural.	1707	1494	82	1245	267	1,200,000
	Select structural.	1280	1322	70	1100	267	
	Heart structural.	1024	1150	56	1000	267	
Spruce, Englemann	Select	750	750	70	600	175	800,000
	Common	600	600	56	480		
Spruce, red, white, Sitka	Select	1100	1100	85	800	250	1,200,000
	Common	880	880	68	640		
Tamarack, eastern	Select	1200	1200	95	1000	300	1,300,000
	Common	960	960	76	800		

[1]Working stresses for grades and species shown above are based upon recommendations from lumber manufacturers associations whose members produce the respective species.

TABLE 159

ALLOWABLE UNIT STRESSES FOR STRUCTURAL LUMBER AND TIMBERS

LOCATIONS OCCASIONALLY WET

Applies to use in such exterior structures as bridges, trestles, grandstands, bleachers, and exposed framework of open sheds

SPECIES OF TIMBER[1]	GRADES[1]	ALLOWABLE UNIT STRESS IN POUNDS PER SQUARE INCH					
		Extreme Fiber in Bending		*Maximum Horizontal Shear*	*Compression*		*Modulus of Elasticity*
		Joists & Plank Sizes; 4" and Less in Thickness	*Beams & Stringer Sizes; 5" and Thicker*		*Parallel to Grain (Short Columns)*	*Perpendicular to Grain*	
Cedar, Alaska	Select	890	1000	90	744	200	1,200,000
	Common	760	800	72	597		
Cedar, northern and southern white	Select	580	650	70	496	140	800,000
	Common	490	520	56	398		
Cedar, Port Orford	Select	890	1000	90	818	200	1,200,000
	Common	760	800	72	656		
Cedar, western red	Select	710	800	80	693	150	1,000,000
	Common	600	640	64	557		
Cypress, southern	Select	980	1100	100	986	250	1,200,000
	Common	830	880	80	793		
Douglas fir, Coast region	Dense super-structural	1500	1733	120	1333	265	
	Super-structural and dense structural	1400	1560	105	1200	240	1,600,000
	Structural	1240	1400	90	1100	240	
	Common structural	980	1200	84	1000	225	
Douglas fir, Inland Empire	Dense super-structural	1500	1733	120	1333	265	1,600,000
	Dense structural	1400	1560	105	1200	240	
	No. 1 common dimension and timbers	975	....	70	830	225	1,500,000
Douglas fir, Rocky Mt. region	Select	800	900	85	793	225	1,200,000
	Common	680	720	68	636		
Fir, balsam	Select	670	750	70	596	125	1,000,000
	Common	570	600	56	478		
Fir, golden, Noble, silver, white, (commercial white	Select	800	900	70	694	225	1,100,000
	Common	680	720	56	557		
Hemlock, eastern	Select	800	900	70	694	225	1,100,000
	Common	680	720	56	557		
Hemlock, West Coast	Select	980	1100	75	893	225	1,400,000
	Common	830	880	60	716		
Larch, western	No. 1 common dimension and timbers	975	....	70	830	225	1,300,000
Pine, Calif., Idaho and northern white lodgepole, Pondosa, sugar	Select	710	800	85	742	150	1,000,000
	Common	600	640	68	596		
Pine, Norway	Select	890	1000	85	793	175	1,200,000
	Common	760	800	68	637		
Pine, southern yellow	Extra dense select structural	1900	1900	200	1450	375	
	Select structural	1700	1700	175	1300	300	
	Extra dense heart	1700	1700	175	1300	375	1,600,000
	Dense heart	1500	1500	150	1150	300	
	Structural square edge and sound	1350	1350	125	1050	300	
	No. 1 common	1050	1050	100	900	250	
Redwood	Super-structural	1420	1422	93	1280	160	
	Prime structural	1182	1245	82	1120	160	1,200,000
	Select structural	948	1100	70	990	160	
	Heart structural	805	960	56	900	160	
Spruce, Englemann	Select	580	650	70	545	140	800,000
	Common	490	520	56	437		
Spruce, red, white, Sitka	Select	800	900	85	744	150	1,200,000
	Common	680	720	68	597		
Tamarack, eastern	Select	980	1100	95	892	225	1,300,000
	Common	830	880	76	716		

[1] Working stresses for grades and species shown above are based upon recommendations from lumber manufacturers associations whose members produce the respective species.

TABLE 160

ALLOWABLE UNIT STRESSES FOR STRUCTURAL LUMBER AND TIMBERS

LOCATIONS USUALLY WET

Applies to use where material is exposed to waves of tide water or in contact with earth or used in building in positions that would be more or less continuously wet

SPECIES OF TIMBER[1]	GRADES[1]	ALLOWABLE UNIT STRESS IN POUNDS PER SQUARE INCH					
		Extreme Fiber in Bending		*Maximum Horizontal Shear*	*Compression*		*Modulus of Elasticity*
		Joists & Plank Sizes; 4" and Less in Thickness	*Beams & Stringer Sizes; 5" and Thicker*		*Parallel to Grain (Short Columns)*	*Perpendicular to Grain*	
Cedar, Alaska	Select	800	900	90	646	150	1,200,000
	Common	680	720	72	518		
Cedar, northern and southern white	Select	530	600	70	447	100	800,000
	Common	450	480	56	358		
Cedar, Port Orford	Select	800	900	90	744	150	1,200,000
	Common	680	720	72	597		
Cedar, western red	Select	670	750	80	645	125	1,000,000
	Common	570	600	64	517		
Cypress, southern	Select	800	900	100	793	225	1,200,000
	Common	680	720	80	636		
Douglas fir, Coast region	Dense super-structural	1150	1333	120	1133	235	
	Super-structural and dense structural	1080	1200	105	1000	215	1,600,000
	Structural	950	1100	90	935	215	
	Common structural	750	935	84	850	200	
Douglas fir, Inland Empire	Dense super-structural	1150	1333	120	1133	235	
	Dense structural	1080	1200	105	1000	215	1,600,000
	No. 1 common dimension and timbers	705	....	70	655	200	1,500,000
Douglas fir, Rocky Mt. region	Select	620	700	85	695	200	1,200,000
	Common	530	560	68	558		
Fir, balsam	Select	530	600	70	498	100	1,000,000
	Common	450	480	56	399		
Fir, golden, Noble, silver, white (commercial white)	Select	710	800	70	596	200	1,100,000
	Common	600	640	56	478		
Hemlock, eastern	Select	710	800	70	596	200	1,100,000
	Common	600	640	56	478		
Hemlock, West Coast	Select	800	900	75	795	200	1,400,000
	Common	680	729	60	637		
Larch, western	No. 1 common dimensions and timbers	705	....	70	655	200	1,300,000
Pine, California, Idaho, and northern white, lodgepole, Pondosa, sugar	Select	670	750	85	645	125	1,000,000
	Common	570	600	68	517		
Pine, Norway	Select	710	800	85	695	150	1,200,000
	Common	600	640	68	558		
Pine, southern yellow	Extra dense select structural	1500	1500	200	1200	325	
	Select structural	1300	1300	175	1100	250	1,600,000
	Extra dense heart	1300	1300	175	1100	325	
	Dense heart	1200	1200	150	1000	250	
	Struct. square edge and sound	1100	1100	125	950	250	
	No. 1 common	800	800	100	800	200	
Redwood	Super-structural	1135	1138	93	1067	133	
	Prime structural	945	995	82	933	133	1,200,000
	Select structural	758	880	70	825	133	
	Heart structural	644	768	56	750	133	
Spruce Englemann	Select	440	500	70	447	100	800,000
	Common	370	400	56	358		
Spruce, red, white, Sitka	Select	710	800	85	646	125	1,200,000
	Common	600	640	68	516		
Tamarack, eastern	Select	800	900	95	794	200	1,300,000
	Common	680	720	76	637		

[1] Working stresses for grades and species shown above are based upon recommendations from lumber manufacturers associations whose members produce the respective species.

TABLE 161

NAIL HOLDING POWER OF VARIOUS SPECIES OF WOOD[1]

[7d cement-coated nails driven to a depth of one and one-quarter inches and pulled at once.]

Common and Botanical Name of Species	*Place of Growth of Material Tested*	*Number of Trees*	*Moisture Content Per Cent*	*Specific Gravity Based on Volume and Weight of Oven-dry Wood*	*Av. Holding Power for One Nail when Driven into*		
					End Surface Pounds	*Radial Surface (Edge-grain) Pounds*	*Tangential Surface (Flat-grain) Pounds*
Ash, white (Fraxinus americana)	Arkansas	5	8.9	0.64	385	455	452
Aspen (Populus tremuloides)	Colorado	..	4.3	.36	93	145	157
Aspen, largetooth (Populus grandidentata)	Wisconsin	5	6.5	.41	157	202	207
Basswood (Tilia glabra)	Pennsylvania	5	6.5	.41	138	199	194
Beech (Fagus grandifolia)	Indiana	5	8.4	.67	358	495	460
Birch, yellow (Betula lutea)	Wisconsin	5	8.6	.66	331	473	451
Cedar, western red (Thuja plicata)	Mont., Wash	10	7.6	.34	118	192	202
Cedar, northern white (Thuja plicata)	Wisconsin	5	9.3	.32	103	153	160
Chestnut (Castanea dentata)	Md., Tenn.	10	9.2	.45	172	258	273
Cottonwood, black (Populus trichocarpa)	Washington	5	5.9	.37	122	194	196
Cottonwood, eastern (Populus deltoides)		..	6.8	.34	143	189	197
Cypress, southern (Taxodium distichum)	La., Mo.	10	8.3	.47	144	266	291
Douglas fir (Pseudotsuga taxifolia)	Ore., Wash.	28	6.3	.51	183	273	296
Elm, American (Ulmus americana)	Pennsylvania	5	8.2	.54	236	344	339
Fir, California red (Abies magnifica)	California	3	9.0	.37	100	177	189
Fir, silver (Abies amabilis)	Washington	5	4.9	.40	86	201	207
Fir, white (Abies concolor)	California	3	8.0	.41	104	176	203
Fir, lowland white (Abies grandis)	Idaho	5	5.3	.36	60	150	182
Gum, red (Liquidambar styraciflua)	Arkansas	..	8.3	.51	192	292	278
Gum, tupelo (Nyssa aquatica)	La., Mo.	6	9.3	.52	233	376	345
Hemlock, eastern (Tsuga canadensis)	Tenn., Wis.	28	8.9	.42	127	225	230
Hemlock, western (Tsuga heterophylla)	Washington	9	6.7	.46	149	266	277
Hop-hornbeam (Ostrya virginiana)	Wisconsin	3	6.5	.76	457	513	480
Larch, western (Larix occidentalis)	Idaho	5	4.4	.58	180	299	319
Locust, black (Robinia pseudoacacia)	Tennessee	3	4.1	.71	404	461	345
Locust, honey (Gleditsia triacanthos)	Indiana	1	6.5	.76	431	508	449
Magnolia, cucumber (Magnolia acuminata)	Tennessee	5	5.1	.52	233	350	335
Maple, black (Acer nigrum)	Indiana	1	9.8	.62	357	480	415
Maple, silver (Acer saccharinum)	Wisconsin	5	6.8	.51	280	333	338
Maple, sugar (Acer saccharum)	Indiana	4	9.2	.65	396	497	459
Oak, red (Quercus borealis)	Ark., Tenn., N. H.	22	8.4	.66	312	466	422
Oak, white (Quercus alba)	Ark., La.	10	8.6	.72	320	496	444
Pine, jack (Pinus banksiana)	Wisconsin	5	7.6	.46	161	228	272
Pine, loblolly (Pinus tæda)	Florida	10	8.0	.59	179	271	335
Pine, lodgepole (Pinus contorta)	Colo., Idaho	8	6.3	.44	141	244	252
Pine, Longleaf (Pinus palustris)	Fla., La., Miss.	34	7.7	64	244	362	376
Pine, mountain (Pinus pungens)	Tennessee	5	7.1	.55	209	318	330
Pine, Norway (Pinus resinosa)	Wisconsin	5	7.4	.51	165	273	282
Pine, pitch (Pinus rigida)	Tennessee	5	7.7	.54	235	325	330
Pine, pond (Pinus rigida serotina)	Florida	5	7.5	.57	211	348	384
Pine, Shortleaf (Pinus echinata)	Louisiana	6	7.2	.58	235	331	377
Pine, slash (Pinus caribæa)	Florida	5	7.6	.68	290	356	420
Pine, northern white (Pinus strobus)	Wisconsin	5	7.7	.39	136	220	225
Pine, western white (Pinus monticola)	Montana	5	8.2	.45	134	255	246
Pine, western yellow (Pinus ponderosa)	Calif., Ore.	7	6.6	.44	122	224	233
Poplar, yellow (Liriodendron tulipifera)	Tennessee	5	7.3	.42	162	212	223
Spruce, Engelmann (Picea engelmannii)	Colorado	5	9.4	.36	136	177	184
Spruce, red (Picea rubra)	Tennessee	5	10.7	.41	148	229	221
Spruce, white (Picea glauca)	Wisconsin	5	7.6	.43	146	209	218
Sycamore (Platanus occidentalis)	Tennessee	5	7.0	.55	270	369	349

[1] Forest Products Laboratory.

NOTE.—The nail holding properties of wood are in general closely related to the specific gravity or density of the material but species characteristics may, however, account for variations of as much as 25 percent in these relations. Since in any species there is variation in specific gravity (one-half of the material falling within about 8 per cent of the average specific gravity) the nail-holding properties of individual pieces may vary considerably from the averages presented (one-half of the material falling within about 12 per cent of the average nail-holding value for the species). Hence it is possible to select material of any species that is relatively high in nail-holding properties and is better than the average.

TABLE 162

Table Showing Transportation Charges per Thousand Feet at Given Weights and Rates

Compiled by the Hardwood Manufacturers Institute

Freight Rate in Cents Per One Hundred Pounds

Weight per Thousand Ft. (Pounds)	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
	Transportation Charge Per Thousand Feet																	
1100..	1.75	1.75	2.00	2.00	2.00	2.25	2.50	2.50	2.50	2.75	2.75	3.00	3.00	3.00	3.25	3.25	3.50	3.50
1200..	1.75	2.00	2.00	2.25	2.25	2.50	2.50	2.75	2.75	3.00	3.00	3.25	3.25	3.50	3.50	3.75	3.75	3.75
1300..	2.00	2.00	2.25	2.25	2.50	2.75	2.75	3.00	3.00	3.25	3.25	3.50	3.50	3.75	3.75	4.00	4.00	4.25
1400..	2.25	2.25	2.50	2.50	2.75	3.00	3.00	3.00	3.25	3.50	3.50	3.75	3.75	4.00	4.00	4.25	4.25	4.50
1500..	2.25	2.50	2.50	2.75	3.00	3.00	3.25	3.25	3.50	3.75	3.75	4.00	4.00	4.25	4.50	4.50	4.75	4.75
1600..	2.50	2.50	2.75	3.00	3.00	3.25	3.50	3.50	3.75	4.00	4.00	4.25	4.25	4.50	4.75	4.75	5.00	5.25
1700..	2.50	2.75	3.00	3.00	3.25	3.50	3.50	3.75	4.00	4.00	4.25	4.50	4.50	4.75	5.00	5.25	5.25	5.50
1800..	2.75	3.00	3.00	3.25	3.50	3.75	3.75	4.00	4.25	4.25	4.50	4.75	5.00	5.00	5.25	5.50	5.50	5.75
1900..	3.00	3.00	3.25	3.50	3.75	3.75	4.00	4.25	4.50	4.50	4.75	5.00	5.25	5.25	5.50	5.75	6.00	6.00
2000..	3.00	3.25	3.50	3.75	3.75	4.00	4.25	4.50	4.75	4.75	5.00	5.25	5.50	5.75	5.75	6.00	6.25	6.50
2100..	3.25	3.50	3.50	3.75	4.00	4.25	4.50	4.75	4.75	5.00	5.25	5.50	5.75	6.00	6.00	6.25	6.50	6.75
2200..	3.25	3.50	3.75	4.00	4.25	4.50	4.75	4.75	5.00	5.25	5.50	5.75	6.00	6.25	6.50	6.75	6.75	7.00
2300..	3.50	3.75	4.00	4.25	4.50	4.75	4.75	5.00	5.25	5.50	5.75	6.00	6.25	6.50	6.75	7.00	7.25	7.50
2400..	3.75	3.75	4.00	4.25	4.50	4.75	5.00	5.25	5.50	5.75	6.00	6.25	6.50	6.75	7.00	7.25	7.50	7.75
2500..	3.75	4.00	4.25	4.50	4.75	5.00	5.25	5.50	5.75	6.00	6.25	6.50	6.75	7.00	7.25	7.50	7.75	8.00
2600..	4.00	4.25	4.50	4.75	5.00	5.25	5.50	5.75	6.00	6.25	6.50	6.75	7.00	7.25	7.50	7.75	8.00	8.25
2700..	4.00	4.25	4.50	5.00	5.25	5.50	5.75	6.00	6.25	6.50	6.75	7.00	7.25	7.50	7.75	8.25	8.50	8.75
2800..	4.25	4.50	4.75	5.00	5.25	5.75	6.00	6.25	6.50	6.75	7.00	7.25	7.50	7.75	8.25	8.50	8.75	9.00
2900..	4.50	4.75	5.00	5.25	5.50	5.75	6.00	6.50	6.75	7.00	7.25	7.50	7.75	8.25	8.50	8.75	9.00	9.25
3000..	4.50	4.75	5.25	5.50	5.75	6.00	6.25	6.75	7.00	7.25	7.50	7.75	8.25	8.50	8.75	9.00	9.25	9.75
3100..	4.75	5.00	5.25	5.50	6.00	6.25	6.50	6.75	7.25	7.50	7.75	8.00	8.50	8.75	9.00	9.25	9.75	10.00
3200..	4.75	5.25	5.50	5.75	6.00	6.50	6.75	7.00	7.50	7.75	8.00	8.25	8.75	9.00	9.25	9.75	10.00	10.25
3300..	5.00	5.25	5.75	6.00	6.25	6.75	7.00	7.25	7.50	8.00	8.25	8.50	9.00	9.25	9.50	10.00	10.25	10.50
3400..	5.25	5.50	5.75	6.25	6.50	6.75	7.25	7.50	7.75	8.25	8.50	8.75	9.25	9.50	10.00	10.25	10.50	11.00
3500..	5.25	5.75	6.00	6.25	6.75	7.00	7.50	7.75	8.00	8.50	8.75	9.25	9.50	9.75	10.25	10.50	11.00	11.25
3600..	5.50	5.75	6.25	6.50	6.75	7.25	7.50	8.00	8.25	8.75	9.00	9.50	9.75	10.00	10.50	10.75	11.25	11.50
3700..	5.50	6.00	6.25	6.75	7.00	7.50	7.75	8.25	8.50	9.00	9.25	9.75	10.00	10.50	10.75	11.25	11.50	12.00
3800..	5.75	6.00	6.50	6.75	7.25	7.75	8.00	8.50	8.75	9.25	9.50	10.00	10.25	10.75	11.00	11.50	11.75	12.25
3900..	6.00	6.25	6.75	7.00	7.50	7.75	8.25	8.50	9.00	9.50	9.75	10.25	10.50	11.00	11.25	11.75	12.00	12.50
4000..	6.00	6.50	6.75	7.25	7.75	8.00	8.50	8.75	9.25	9.75	10.00	10.50	10.75	11.25	11.75	12.00	12.50	12.75
4100..	6.25	6.50	7.00	7.50	7.75	8.25	8.75	9.00	9.50	9.75	10.25	10.75	11.00	11.50	12.00	12.25	12.75	13.25
4200..	6.25	6.75	7.25	7.50	8.00	8.50	8.75	9.25	9.75	10.00	10.50	11.00	11.25	11.75	12.25	12.75	13.00	13.50
4300..	6.50	7.00	7.25	7.75	8.25	8.75	9.00	9.50	10.00	10.25	10.75	11.25	11.75	12.00	12.50	13.00	13.50	13.75
4400..	6.75	7.00	7.50	8.00	8.50	8.75	9.25	9.75	10.25	10.50	11.00	11.50	12.00	12.25	12.75	13.25	13.75	14.00
4500..	6.75	7.25	7.75	8.25	8.50	9.00	9.50	10.00	10.50	10.75	11.25	11.75	12.25	12.75	13.00	13.50	14.00	14.50
4600..	7.00	7.50	7.75	8.25	8.75	9.25	9.75	10.25	10.50	11.00	11.50	12.00	12.50	13.00	13.25	14.00	14.25	14.75
4700..	7.00	7.50	8.00	8.50	9.00	9.50	10.00	10.25	10.75	11.25	11.75	12.25	12.75	13.25	13.75	14.25	14.50	15.00
4800..	7.25	7.75	8.25	8.75	9.25	9.75	10.00	10.50	11.00	11.50	12.00	12.50	13.00	13.50	14.00	14.50	15.00	15.50
4900..	7.50	7.75	8.50	8.75	9.25	9.75	10.25	10.75	11.25	11.75	12.25	12.75	13.25	13.75	14.25	14.75	15.25	15.75
5000..	7.50	8.00	8.50	9.00	9.50	10.00	10.50	11.00	11.50	12.00	12.50	13.00	13.50	14.00	14.50	15.00	15.50	16.00

Compiled by the Hardwood Manufacturers Institute

Freight Rate in Cents Per One Hundred Pounds

Weight Per Thousand Ft. (Pounds)	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
	Transportation Charge Per Thousand Feet																	
1100..	3.75	3.75	4.00	4.00	4.00	4.25	4.25	4.50	4.50	4.75	4.75	4.75	5.00	5.00	5.25	5.25	5.50	5.50
1200..	4.00	4.00	4.25	4.25	4.50	4.50	4.75	4.75	5.00	5.00	5.25	5.25	5.50	5.50	5.75	5.75	6.00	6.00
1300..	4.25	4.50	4.50	4.75	4.75	5.00	5.00	5.25	5.25	5.50	5.50	5.75	6.00	6.00	6.25	6.25	6.50	6.50
1400..	4.75	4.75	5.00	5.00	5.25	5.25	5.50	5.75	5.75	6.00	6.00	6.25	6.25	6.50	6.50	6.75	7.00	7.00
1500..	5.00	5.25	5.25	5.50	5.50	5.75	5.75	6.00	6.25	6.25	6.50	6.75	6.75	7.00	7.00	7.25	7.50	7.50
1600..	5.25	5.50	5.75	5.75	6.00	6.00	6.25	6.50	6.50	6.75	7.00	7.00	7.25	7.50	7.50	7.75	7.75	8.00
1700..	5.75	5.75	6.00	6.25	6.25	6.50	6.75	6.75	7.00	7.20	7.25	7.50	7.75	7.75	8.00	8.25	8.25	8.50
1800..	6.00	6.25	6.25	6.50	6.75	6.75	7.00	7.25	7.50	7.50	7.75	8.00	8.25	8.25	8.50	8.75	8.75	9.00
1900..	6.25	6.50	6.75	6.75	7.00	7.25	7.50	7.75	7.75	8.00	8.25	8.50	8.50	8.75	9.00	9.25	9.25	9.50
2000..	6.75	6.75	7.00	7.25	7.50	7.75	7.75	8.00	8.25	8.50	8.75	8.75	9.00	9.25	9.50	9.75	9.75	10.00
2100..	7.00	7.25	7.50	7.50	7.75	8.00	8.25	8.50	8.75	8.75	9.00	9.25	9.50	9.75	10.00	10.00	10.25	10.50
2200..	7.25	7.50	7.75	8.00	8.25	8.50	8.50	8.75	9.00	9.25	9.50	9.75	10.00	10.25	10.50	10.50	10.75	11.00
2300..	7.50	7.75	8.00	8.50	8.50	8.75	9.00	9.25	9.50	9.75	10.00	10.25	10.50	10.50	11.00	11.00	11.25	11.50
2400..	8.00	8.25	8.50	8.75	9.00	9.25	9.50	9.75	9.75	10.00	10.25	10.50	10.75	11.00	11.25	11.50	11.75	12.00
2500..	8.25	8.50	8.75	9.00	9.25	9.50	9.75	10.00	10.25	10.50	10.75	11.00	11.25	11.50	11.75	12.00	12.25	12.50
2600..	8.50	9.00	9.25	9.50	9.75	10.00	10.25	10.50	10.75	11.00	11.25	11.50	11.75	12.00	12.25	12.50	12.75	13.00
2700..	9.00	9.25	9.50	9.75	10.00	10.25	10.50	10.75	11.00	11.50	11.75	12.00	12.25	12.50	12.75	13.00	13.25	13.50
2800..	9.25	9.50	9.75	10.00	10.50	10.75	11.00	11.25	11.50	11.75	12.00	12.25	12.75	13.00	13.25	13.50	13.75	14.00
2900..	9.50	10.00	10.25	10.50	10.75	11.00	11.25	11.75	12.00	12.25	12.50	12.75	13.00	13.25	13.75	14.00	14.25	14.50
3000	10.00	10.25	10.50	10.75	11.25	11.50	11.75	12.00	12.25	12.75	13.00	13.25	13.50	13.75	14.25	14.50	14.75	15.00
3100..	10.25	10.50	11.00	11.25	11.50	11.75	12.00	12.50	12.75	13.00	13.25	13.75	14.00	14.25	14.50	15.00	15.25	15.50
3200..	10.50	11.00	11.25	11.50	11.75	12.25	12.50	12.75	13.25	13.50	13.75	14.00	14.50	14.75	15.00	15.50	15.75	16.00
3300..	11.00	11.25	11.50	12.00	12.25	12.50	13.00	13.25	13.50	14.00	14.25	14.50	15.00	15.25	15.50	15.75	16.25	16.50
3400..	11.25	11.50	12.00	12.25	12.50	13.00	13.25	13.75	14.00	14.25	14.75	15.00	15.50	15.75	16.00	16.25	16.75	17.00
3500..	11.50	12.00	12.25	12.75	13.00	13.25	13.75	14.00	14.50	14.75	15.00	15.50	15.75	16.25	16.50	16.75	17.25	17.50
3600..	12.00	12.25	12.75	13.00	13.25	13.75	14.00	14.50	14.75	15.25	15.50	15.75	16.25	16.50	17.00	17.25	17.75	18.00
3700..	12.25	12.50	13.00	13.25	13.75	14.00	14.50	14.75	15.25	15.50	16.00	16.25	16.75	17.00	17.50	17.75	18.25	18.50
3800..	12.50	13.00	13.25	13.75	14.00	14.50	14.75	15.25	15.50	16.00	16.25	16.75	17.25	17.50	18.00	18.25	18.75	19.00
3900..	13.00	13.25	13.75	14.00	14.50	14.75	15.25	15.75	16.00	16.50	16.75	17.25	17.50	18.00	18.50	18.75	19.25	19.50
4000..	13.25	13.75	14.00	14.50	14.75	15.25	15.75	16.00	16.50	16.75	17.25	17.75	18.00	18.50	18.75	19.25	19.75	20.00
4100..	13.50	14.00	14.50	14.75	15.25	15.50	16.00	16.50	16.75	17.25	17.75	18.00	18.50	19.00	19.25	19.75	20.00	20.50
4200..	14.00	14.25	14.75	15.25	15.50	16.00	16.50	16.75	17.25	17.75	18.00	18.50	19.00	19.25	19.75	20.25	20.50	21.00
4300..	14.25	14.75	15.00	15.50	16.00	16.25	16.75	17.25	17.75	18.00	18.50	19.00	19.50	19.75	20.25	20.75	21.00	21.50
4400..	14.50	15.00	15.50	15.75	16.25	16.75	17.25	17.75	18.00	18.50	19.00	19.50	19.75	20.25	20.75	21.25	21.50	22.00
4500..	15.00	15.25	15.75	16.25	16.75	17.25	17.50	18.00	18.50	19.00	19.50	19.75	20.25	20.75	21.25	21.75	22.00	22.50
4600..	15.25	15.75	16.25	16.50	17.00	17.50	18.00	18.50	19.00	19.25	19.75	20.25	20.75	21.25	21.75	22.00	22.50	23.00
4700..	15.50	16.00	16.50	17.00	17.50	18.00	18.25	18.75	19.25	19.75	20.25	20.75	21.25	21.75	22.00	22.50	23.00	23.50
4800..	15.75	16.25	16.75	17.25	17.75	18.25	18.75	19.25	19.75	20.25	20.75	21.25	21.75	22.00	22.50	23.00	23.50	24.00
4900..	16.25	16.75	17.25	17.75	18.25	18.75	19.25	19.75	20.00	20.50	21.00	21.50	22.00	22.50	23.00	23.50	24.00	24.50
5000..	16.50	17.00	17.50	18.00	18.50	19.00	19.50	20.00	20.50	21.00	21.50	22.00	22.50	23.00	23.50	24.00	24.50	25.00

TABLE 163

LUMBER USED IN MANUFACTURE, 1928[1]

QUANTITIES IN THOUSAND FEET, BOARD MEASURE[2]

By States and Regions

Alabama	417,556
Arizona	33,284
Arkansas	459,865
California	1,385,822
Colorado	64,918
Connecticut	68,169
Delaware	35,888
Dist. of Col	4,385
Florida	266,316
Georgia	427,190
Idaho	297,087
Illinois	784,534
Indiana	561,128
Iowa	220,388
Kansas	62,154
Kentucky	245,486
Louisiana	648,970
Maine	219,575
Maryland	161,475
Massachusetts	414,202
Michigan	1,252,627
Minnesota	281,839
Mississippi	644,334
Missouri	275,675
Montana	100,011
Nebraska	46,881
Nevada	6,836
New Hampshire	189,869
New Jersey	237,197
New Mexico	59,291
New York	817,284
North Carolina	690,607
North Dakota	3,286
Ohio	560,592
Oklahoma	72,806
Oregon	1,338,179
Pennsylvania	632,049
Rhode Island	22,547
South Carolina	271,162
South Dakota	21,508
Tennessee	514,031
Texas	444,902
Utah	9,884
Vermont	88,508
Virginia	477,797
Washington	2,047,094
West Virginia	115,746
Wisconsin	695,029
Wyoming	2,477
All States	18,698,440

Regional Summary

New England	1,002,870
Middle Atlantic	1,888,278
Lake States	2,229,495
Central Hardwood	3,057,192
N. C. Pine	1,439,566
Southern Pine	3,381,939
Pacific (North)	3,385,273
Pacific (South)	1,392,658
Rocky Mt. (North)	397,098
Rocky Mt. (South)	169,854
Prairie	354,217
All Regions	18,698,440

By Industries

Airplanes	9,044
Agricultural implements	142,943
Artificial limbs	698
Boot and shoe findings	48,742
Baskets and fruit packages	261,530
Boxes and crates	4,719,700
Boxes, cigar and tobacco	38,429
Brooms and carpet sweepers	28,452
Brushes	17,033
Bungs and faucets	2,980
Butcher's blocks and skewers	4,888
Car construction and repair	1,009,408
Caskets and coffins	156,108
Chairs and chair stock	165,392
Clocks	3,511
Dairymen's, poulterers' and apiarists' supplies	41,037
Woodenware and novelties	142,299
Dowels	15,087
Elevators	46
Equipment, playground	4,672
Firearms	1,741
Fixtures	130,030
Frames and molding, picture	20,947
Furniture	1,198,612
Gates and fencing	1,572
Handles	124,654
Instruments, professional and scientific	15,510
Instruments, musical	107,502
Laundry appliances	38,674
Machine construction	39,627
Machinery and apparatus, electrical	66,750
Matches	115,943
Toothpicks	7,483
Mine equipment	22
Motion picture and theatrical scenery	16,223
Patterns and flasks	29,996
Paving materials and conduits	3,350
Pencils and penholders	39,982
Pipes, tobacco	1,411
Planing mill products	[a] 5,063,583
Plumbers' woodwork	16,273
Printing material	5,984
Pulleys and conveyors	900
Pumps and wood pipe	10,831
Refrigerators and kitchen cabinets	145,745
Rollers, shade and map	24,236
Saddles and harness	751
Sash, doors, blinds and general millwork	3,317,346

[1] In addition to lumber the amounts given in this table include also two other classes of raw material, quantities for which have been converted into board feet; bolts and logs comprise 3 per cent, and veneer and plywood 2 per cent of the total.

[2] Lumber Used in Manufacture—1928; Canvas conducted by Department of Agriculture in coöperation with the U. S. Department of Commerce—Bureau of Census—issued May, 1930.

[a] "Planing mill products" includes products worked to pattern, such as flooring, ceiling, and siding, but excludes lumber merely dressed.

TABLE 163—*Continued*

Sewing machines	12,760
Ship and boat building	128,342
Shuttles, spools and bobbins	44,022
Signs and supplies	48,597
Sporting and athletic goods	29,973
Tanks and silos	66,328
Toys	39,410
Trunks and valises	21,346
Vehicles (non-motor)	80,841
Vehicles (motor)	867,875
Weighing apparatus	19
Whips, canes, and umbrella sticks	1,250
All Industries	18,698,440

By Kinds of Wood

Cedar, eastern red	31,600
Cedar, eastern white	11,206
Cedar, western	204,835
Cypress	279,276
Douglas fir	2,547,429
True firs	72,598
Hemlock	575,124
Larch	34,646
Pine, southern yellow	4,708,833
Pine, western yellow	[b] 2,109,344
Pine, white	[c] 1,407,092
Redwood	145,920
Spruce	503,097
Yew	2
Misc. native softwoods	30
Alder	18,358
Applewood	60
Ash	179,979
Basswood	163,324
Beech	148,387
Birch	515,230
Buckeye	2,357
Butternut	372
Cherry	7,255
Chestnut	194,664
Cottonwood	182,309
Dogwood	3,414
Elm	166,136
Hackberry	4,559
Hickory	145,720
Holly	32
Hornbeam	65
Locust	9,273
Maple	752,371
Myrtle	70
Oak	1,408,756
Osage orange	20
Pecan	2,523
Persimmon	2,158
Red (and sap) gum	1,226,285
Sycamore	37,477
Tupelo	255,723
Walnut	78,210
Willow	7,170
Yellow poplar	[d] 450,549
Misc. native hardwoods	920
Balsa	306
Beech, European	10
Box, Turkish	129
Box, West Indian	422
Cedar, Spanish	6,964
Cocobola	542
Ebony	175
Eucalyptus	311
Hazel	18
Khaya ("African mahogany")	1,852
Laurel	75
Lignum-vitæ	709
Mahogany	63,305
Oak, Japanese or English	155
Padouk	22
Philippine hardwoods	24,341
Prima vera	31
Rakuda	25
Rosewood	521
Satinwood	61
Snakewood	103
Teak	1,297
Walnut, Circassian	224
Misc. foreign woods	2,084
All Woods	18,698,440

[b] Includes lodgepole pine.

[c] White pine includes northern white pine, western white pine (often called Idaho white pine), sugar pine, and Norway pine.

[d] Yellow poplar includes also cucumber and magnolia.

TABLE 164

PRODUCTION OF THE LEADING KINDS OF LUMBER—1928

Hardwoods			Softwoods		
Species	*Production M Board Feet*	*Per Cent of Total*	*Species*	*Production M Board Feet*	*Per Cent of Total*
Oak	1,830,260	5.4	Yellow Pine	10,610,290	31.1
Red gum	967,756	2.5	Douglas fir	8,449,282	24.8
Maple	742,642	2.2	Pondosa Pine (western yellow pine)	2,975,748	8.7
Birch	337,550	1.0	Hemlock	2,221,756	6.5
Yellow Poplar	327,833	1.0	White Pine	1,366,933	4.0
Tupelo	316,554	1.0	Spruce	571,917	1.7
Chestnut	259,769	.8	Cypress	501,422	1.5
Elm	155,903	.5	Redwood	486,827	1.4
Beech	146,207	.5	Sugar Pine	305,940	.9
Cottonwood	143,562	.4	White Fir	292,085	.9
Basswood	140,094	.4	Cedar	266,877	.8
Ash	130,099	.4	Larch	250,518	.7
Walnut	56,650	.2	Lodgepole Pine	26,537	.1
Hickory	47,786	.1	Balsam Fir	19,066	...
Sycamore	38,454	.1			
Total	5,641,119	16.4		28,345,198	83.1

Summary

Softwoods	28,345,198 M board feet or	83.1 per cent
Hardwoods	5,641,119 M board feet or	16.4 per cent
Other	155,806 M board feet or	.5 per cent
Total	34,142,123 M board feet or	100.0 per cent

STANDARD LUMBER ABBREVIATIONS

Lumber—Simplified Practice Recommendation No. 16—Bureau of Standards—states, "The following standard lumber abbreviations when used in contracts and other documents arising in the transactions of purchase and sale of American standard lumber shall be construed as hereinafter provided:

AD.....Air-dried
a.l.....All lengths
av.....Average
av.w.....Average width
av.l.....Average length
a.w.....All widths
B1S.....Beaded one side
B2S.....Beaded two sides
BBS.....Box bark strips
bd.....Board
bd.ft.....Board foot; that is, an area of 1 square foot by 1 inch thick
bdl.....Bundle
bdl.bk.s.....Bundled bark strips
Bev.....Bevelled
B/L.....Bill of lading
b.m.....Board (foot) measure
Btr.....Better
c. & f.....(*Named port.*) *Cost and freight to named port.* Term used when the seller is ready to go farther than the delivery of his goods upon a vessel and is willing to pay transportation to another port
c.i.f.....(*Named port.*) *Cost, insurance, and freight to a named port.* Term used when the seller desires to quote a price covering the cost of the goods, the marine insurance on the goods, and all transportation charges to the point of delivery
c.i.f.e.....(*Named port.*) *Cost, insurance, freight, and exchange to a named port.* This is the same as c.i.f. with the additional provision that the seller guarantees the buyer against loss due to a decline in the rate of exchange
Clg.....Ceiling
Clr.....Clear
CM.....Center matched; that is, the tongue and groove joints are worked along the center of the edges of the piece
Com.....Common
Coop.....Cooperage (stock)
Csg.....Casing
Ctg.....Crating
cu.ft.....Cubic foot
Cust.....Custom (sawed)
D & CM.....Dressed (one or two sides) and center matched
D & H.....Dressed and headed; that is, dressed one or two sides and worked to tongue and groove joints on both the edge and the ends.
D & M.....Dressed and matched; that is, dressed one or two sides and tongued and grooved on the edges. The match may be center or standard
D & SM.....Dressed (one or two sides) and standard matched
D2S & CM....Dressed two sides and center matched
D2S & M.....Dressed two sides and (center or standard) matched
D2S & SM.....Dressed two sides and standard matched
Dim.....Dimension
D.S.....Drop siding
E.....Edge
E & CB1S.....Edge and center bead one side; surfaced one or two sides and with a longitudinal edge and center bead on a surfaced face
E & CB2S.....Edge and center bead two sides; all four sides surfaced and with a longitudinal edge and center bead on the two faces
ECM.....Ends center matched
E & CV1S.....Edge and center V one side; surfaced one or two sides and with a longitudinal edge and center V-shaped groove on a surfaced face
E & CV2S.....Edge and center V two sides; all four sides surfaced and with a longitudinal edge and center V-shaped groove on each of the two faces
EG.....Edge grain
EM.....End matched—either center or standard
ESM.....Ends standard matched
exp.....Expert (lumber or timber)
FAS.....Firsts and seconds—a combined grade of the two upper grades of hardwoods
f.a.s.vessel.....(*Named port.*) *Free along side vessel at a named port.* Term used when the seller desires to quote a price covering delivery of the goods alongside a vessel and within reach of its loading tackle

f.bk.....Flat back
fcty.....Factory (lumber)
F.G.....Flat grain
Flg.....Flooring
f.o.b.....(*Named shipment point.*) *Free on board at a named shipping point.* Term used when the price quoted applies only to an inland shipping point and the seller merely undertakes to load the goods on or in cars or lighters furnished by the railroad company serving the industry, or most conveniently located to the industry, without other designation as to routing
f.o.b.....(*Named point.*) *Freight prepaid to* (*named point*). *Free on board at a named point and freight prepaid to a named point.* Term used when the seller quotes a price including transportation charges to a given point without assuming responsibility for the goods after obtaining a clean bill of lading at point of origin
f.o.b.....(*Named point.*) *Freight allowed to* (*named point*). *Free on board at a named point and freight allowed to a named point.* Term used where the seller wishes to quote a price from which the buyer may deduct the cost of transportation to the point of destination, without the seller assuming responsibility for the goods after obtaining a clean bill of lading at the point of origin
f.o.b.....(*Named port.*) *Lighterage free. Free on board at a named port with lighterage free.* Term used when seller desires to quote a price which will include the expense of transportation of the goods by rail to the seaboard, including lighterage
f.o.b. cars.....(*Named destination point.*) *Free on board cars at a named destination point.* Term used when the seller desires to quote a price covering the transportation of the goods to a given point, assuming responsibility for loss and/or damage up to that point
f.o.b. cars.....(*Named point.*) *Free on board cars at a named point less carload lots.* Term used when the goods on which a price is quoted to a given point, constitutes less than a carload lot
f.o.b. vessel....(*Named port.*) *Free on board vessel at a named port.* Term used when the seller desires to quote a price covering all expenses up to and including delivery of the goods upon a vessel at a named port
f.o.k.....Free of knots
f.o.w.....First open water
Frm.....Framing
ft.....Foot or feet. Also one accent (′). *See* Symbols
ft.b.m.....Feet board measure
ft.s.m.....Feet surface measure
Furn.....Furniture (stock)
G.R.....Grooved roofing
H.bk.....Hollow back
Hdl.....Handle (stock)
hdwd.....Hardwood
Hrt.....Heart
Hrtwd.....Heartwood
1s & 2s.....Ones and twos—a combined grade of the hardwood grades of first and seconds
Impl.....Implement (stock)
in.....Inch or inches. Also two accent marks (″). *See* Symbols
KD.....Kiln-dried
k.d.....Knocked down
lbr.....Lumber
l.c.l.....Less carload lots
lgth.....Length
lgr.....Longer
lin.ft.....Lineal foot; that is, 12 inches
Lng.....Lining
LR.....Log run
LR, MCO.....Log run, mill culls out
Lth.....Lath
M.....Thousand
M.b.m.....Thousand (feet) board measure
MCO.....Mill culls out
Merch.....Merchantable
m.l.....Mixed lengths
Mldg.....Molding
MR.....Mill run
M.s.m.....Thousand (feet) surface measure
m.w.....Mixed widths
No.....Number
Ord.....Order
P.....Planed
Pat.....Pattern
Pky.....Pecky
Pln.....Plain, as plain-sawed
Pn.....Partition
Prod.....Production
Qtd.....Quartered—When referring to hardwoods
rdm.....Random
res.....Resawed
Rfg.....Roofing
Rfrs.....Roofers
rip.....Ripped
r.l.....Random lengths
rnd.....Round
R.Sdg.....Rustic siding
r.w.....Random widths
S & E.....Surface one side and one edge
S1E.....Surfaced one edge
S2E.....Surfaced two edges
S1S.....Surfaced one side
S2S.....Surfaced two sides
S1S1E.....Surfaced one side and one edge
S1S1E.....Surfaced two sides and one edge
S1S2E.....Surfaced one side and two edges
S4S.....Surfaced four sides
S4SCS.....Surfaced four sides with a calking seam on each edge
S & CM.....Surfaced (one or two sides) and center matched

S & M.....Surfaced and matched; that is, surfaced one or two sides and tongued and grooved on the edges. The match may be center or standard
S & SM.....Surfaced (one of two sides) and standard matched
S2S & CM.....Surfaced two sides and center matched
S2S & M.....Surfaced two sides and (center or standard) matched
S2S & SM.....Surfaced two sides and standard matched
Sap.....Sapwood
SB.....Standard bead
Sd.....Seasoned
Sdg.....Siding
Sel.....Select
S.E.Sdg.....Square edge siding
s.f.....Surface foot; that is, an area of one square foot
Sftwd.....Softwood
Sh.D.....Shipping dry
Ship.....Shipment or shipments
Shlp.....Shiplap
s.m.....Surface measure
SM.....Standard matched
smkd.....Smoked (dried)
smk.stnd.....Smoke stained
s.n.d.....Sap no defect
snd.....Sound
sq.....Square
Sq.E. & S.....Square edged and sound
sqrs.....Squares
Std.....Standard
stnd.....Stained
stk.....Stock
Stp.....Stepping
S.W.....Sound wormy
Symbols: ″—inch or inches, as 12″
′—foot or feet, as 12′
x—by, as a 6 x 8 timber
4/4, 5/4, 6/4, 8/4, etc. = 1 inch, 1¼ inches, 1½ inches, 2 inches, etc., when referring to the size of lumber
T & G.....Tongued and grooved
TB & S.....Top, bottom, and sides
Tbrs.....Timbers
V1S.....V one side; that is, a longitudinal V-shaped groove on one face of a piece of lumber
V2S.....V two sides; that is, a longitudinal V-shaped groove on two faces of a piece of lumber
V.G.....Vertical grain
w.a.l.....Wider, all lengths
Wth.....Width
wdr.....Wider
Wgn.....Wagon (stock)
wt.....Weight

ASSOCIATIONS

NOTE.—In addition to the associations listed below there are numerous others interested in particular lumber products.

American Society of Mechanical Engineers—29 West 39th Street, New York, N. Y.

American Walnut Manufacturers' Association—616 South Michigan Avenue, Chicago, Ill.

American Wood Preservers' Association—Chandler Building, Washington, D. C.

Appalachian Hardwood Club—Southern Building, Cincinnati, Ohio

Arizona, New Mexico White Pine Manufacturers' Association—Occidental Building, Albuquerque, New Mexico

Arkansaw Soft Pine Bureau—Little Rock, Arkansas

Associated Leaders of Lumber and Fuel Dealers of America—7539 Sheridan Road, Chicago, Ill.

Association of American Wood Pulp Importers—250 Park Avenue, New York, N. Y.

California-Oregon Lumbermen's Club—Box 266, Klamath Falls, Oregon

California Redwood Association—24 California Street, San Francisco, Cal.

California White and Sugar Pine Manufacturers' Association—Call Building, San Francisco, Cal.

Carolina Retail Lumber Dealers' Association of North and South Carolina—Builders Building, Charlotte, N. C.

Central Committee on Lumber Standards—Transportation Building, Washington, D. C.

Dimension Manufacturers' Association—Louisville, Kentucky

Dogwood and Persimmon Association—Bank of Commerce Building, Memphis, Tenn.

Douglas Fir Plywood Institute—1023 Pacific Avenue, Tacoma, Wash.

Fir Plywood Manufacturers' Association—Spalding Building, Portland, Ore.

Florida Dense Long Leaf Pine Manufacturers' Association—31 Gatlin Avenue, Orlando, Fla.

Hardwood Manufacturers Institute—Bank of Commerce Building, Memphis, Tenn.

Hickory Handle Association—Box 517, South Bend, Ind.

Long Leaf Yellow Pine Manufacturers' Association—Pere Marquette Building, New Orleans, La.

Lumber Manufacturers' Association of Southern New England—Ansonia, Conn.

Maple Flooring Manufacturers' Association—McCormick Building, Chicago, Ill.

Millwork Institute of California—224 Outpost Building, Los Angeles, Calif.

Mountain States Lumber Dealers' Association—Denham Building, Denver, Colo.

Montreal Wholesale Lumber Dealers' Association—Montreal, Quebec.

National-American Wholesale Lumber Association (Inc.)—41 East 42nd Street, New York, N. Y.

National Association of Box Manufacturers—844 Rush Street, Chicago, Ill.

National Association of Railroad Tie Producers—Syndicate Trust Building, St. Louis, Mo.

National Association of Wooden Box Manufacturers—Conway Building, Chicago, Ill.
National Hardwood Lumber Association—59 East Van Buren Street, Chicago, Ill.
National Lumber Manufacturers' Association—Transportation Building, Washington, D. C.
National Plywood Distributors Association—28 East Jackson Boulevard, Chicago, Ill.
National Retail Lumber Dealers' Association—326 West Madison Street, Chicago, Ill.
National Veneer and Panel Association—Strauss Building, Chicago, Ill.
National Woodwork Institute—616 South Michigan Avenue, Chicago, Ill.
New England Yellow Pine Dealers' Association—East Boston, Mass.
North Carolina Pine Association—National Bank of Commerce Building, Norfolk, Va.
Northeastern Retail Lumbermen's Association—Temple Building, Rochester, N. Y.
Northern Hemlock and Hardwood Manufacturers' Association—Oshkosh, Wis.
Northern Pine Manufacturers' Association—Lumber Exchange, Minneapolis, Minn.
Northern White Cedar Association—Lumber Exchange, Minneapolis, Minn.
Northern Wholesale Hardwood Lumber Association—Lumber Exchange, Minneapolis, Minn.
Northwestern Hardwood Lumbermen's Association—Lumber Exchange, Minneapolis, Minn.
Northwestern Lumbermen's Association—1645 Hennepin Avenue, Minneapolis, Minn.
Oak Flooring Manufacturers' Association—Sterick Building, Memphis, Tenn.
Pacific Coast Hardwood Dealers' Association—735 Third Street, San Francisco, Calif.
Pacific Lumber Exporters' Association—Henry Building, Seattle, Wash.
Pacific Lumber Inspection Bureau—Stuart Building, Seattle, Wash.
Philippine Lumber Export Association—Manila, P. I.
Philippine Mahogany Association—Grand Central Terminal, New York, N. Y.
Pine Institute of America (Inc.)—Barnett National Bank Building, Jacksonville, Fla.
Plywood Manufacturers' Association—178 West Adams Street, Chicago, Ill.
Red Cedar Shingle Bureau—First National Bank Building, Chicago, Ill.
Rotary Birch Club—F. R. A. Building, Oshkosh, Wis.
Rotary Cut Box Lumber Manufacturers' Association—Cuthbert, Ga.
Southern Cypress Manufacturers' Association—Barnett National Bank Building, Jacksonville, Fla.
Southern Pine Association—Interstate Bank Building, New Orleans, La.
Southeastern Forest Products Association—Jacksonville, Fla.
Southwestern Hardwood Manufacturers' Club—Whitney Central Building, New Orleans, La.
Southwestern Lumbermen's Association—925 Grand Avenue, Kansas City, Mo.
Washington and Oregon Shingle Association—Stuart Building, Seattle, Wash.
West Coast Lumbermen's Association—Stuart Building, Seattle, Wash.
Western Carolina Lumber and Timber Association—Asheville, N. C.
Western Pine Manufacturers' Association—Yeon Building, Portland, Ore.
Western Red Cedar Association—Peyton Building, Spokane, Wash.
Western Retail Lumbermen's Association—Jones Building, Spokane, Wash.
White Cedar Shingle Manufacturers' Association—Oshkosh, Wis.
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Each entry in this bibliography consists of title, author or sponsoring organization, and the abbreviation of the publisher's name. Following the bibliography is a key to these abbreviations and the addresses of the publishers.

Magazine articles listed in the subject bibliographies are not duplicated here. Back issues of such magazines may be consulted in the larger libraries. Reprints or copies usually may be purchased from the publishers.

This bibliography contains numerous entries not found in other parts of this volume and will well repay study. Many deal with business methods with which to aid those in the lumber industry.

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Kiln Drying of Lumber—Koehler and Thelen, McGraw.

Kiln Drying of Lumber—H. D. Tiemann, Lippincott.

Know the Lumber You Use—National Lumber Manufacturers' Association.

Lightwood, Cut-over Lands, and the Naval Stores Industry—Forest Products Laboratory Mimeo. No. 560.

Limitations to the Use of Sawdust—Forest Products Laboratory Technical Note No. 167.

List of Available Publications of the United States Dept. of Agriculture—Misc. Pub. No. 60, Supt. of Doc. 10¢.

List of Forest Service Publications on Glue and Plywood—Forest Products Laboratory R 513.
List of Publications of the Department of Commerce, Supt. of Doc. 25¢.
List of Publications on Derived Products—Forest Products Laboratory Mimeo. No. 238. Free.
List of Publications on Logging, Manufacture, and Utilization of Timber, Lumber and Other Wooden Products—Forest Products Laboratory Mimeo. No. 790. Free.
List of Publications on Mechanical Properties of Wood and Wood Products—Forest Products Laboratory Mimeo. No. R200. Free.
List of Publications of National Committee on Wood Utilization. Free.
List of Publications of National Lumber Manufacturers' Association. Free.
List of Publications on Pulp and Paper—Forest Products Laboratory Mimeo. No. R444. Free.
List of Publications on Seasoning of Wood—Forest Products Laboratory Mimeo. No. R446. Free.
List of Publications on Wood Preservation—Forest Products Laboratory Mimeo. No. R704. Free.
List of Publications Relating to the Growth, Structure and Identification of Wood—Forest Products Laboratory Mimeo. No. R177. Free.
Logging—R. C. Bryant, Wiley.
Longleaf Pine—Dept. Agriculture Bulletin No. 1061, Supt. of Doc. 15¢.
Looking Ahead Twenty Years on Wood Utility—Grasselli Chemical Company, Cleveland, Ohio.
Loose Leaf Handbook of Wood Preservation Data—American Wood Preservers' Association.
Lumber and Its Uses—R. S. Kellogg, Scientific Bk. Corp.
Lumber and Log Exporters' Guide—Bernard Brereton, P. O. Box 355, Seattle, Wash.
Lumber Industry of the Philippine Islands—Trade Promotion Series No. 24, Dept. of Commerce, Supt. of Doc. 10¢.
Lumber—Its Manufacture and Distribution—R. C. Bryant, Wiley.
Lumber—Simplified Practice Recommendation No. R16–29—Bureau of Standards, Supt. of Doc. 30¢.
Lumbering in the Sugar and Yellow Pine Region of California—Dept. Agriculture Bulletin No. 440, Supt. of Doc. OP.
Lumberman's Actuary—John W. Barry, American Lumberman.
Mahogany, Antique and Modern—W. F. Payson, Dutton.
Manual of Design and Installation of the Forest Service Water-Spray Dry Kiln—Dept. Agriculture Bulletin No. 894, Supt. of Doc. 10¢.
Manual of Instruction for Long-Bell Retail Yards—Long-Bell Lumber Company, Kansas City, Mo.
Manual of the Timbers of the World—Alexander Howard, Macmillan.
Manufacture and Utilization of Hickory—Dept. Agriculture Forest Service Cir. No. 187, Supt. of Doc. OP.
Manufacture of Ethyl Alcohol from Wood Waste—Dept. Agriculture Bulletin No. 983, Supt. of Doc. 15¢.
Manufacture of Ethyl Alcohol from Wood Waste—Forest Products Laboratory Mimeo. No. 668. Free.
Manufacture of Rayon or Cellulose Silk—Forest Products Laboratory Technical Note No. 217. Free.
Manufacture of Veneer—Forest Products Laboratory Mimeo. No. 285. Free.
Maple—Forest Service Leaflet—American Wood Series, Forest Service.
Marketing Fir Lumber in the Middle West—West Coast Lumberman.
Marketing of Short-Length Lumber—National Committee on Wood Utilization, Supt. of Doc. 10¢.
Markets, Foreign Lumber—Numerous publications on this subject, listed in the chapter on "Lumber—Its Manufacture and Utilization," are not duplicated in this General Bibliography.
Mechanical Properties of Redwood—Dept. Agriculture Forest Service Cir. No. 193, Supt. of Doc. 5¢.
Mechanical Properties of Western Larch—Dept. Agriculture Forest Service Bulletin No. 122, Supt. of Doc. OP.
Mechanical Properties of Wood—S. J. Record, Wiley.
Mechanical Properties of Woods Grown in the United States—Dept. Agriculture Bulletin No. 556, Supt. of Doc. 10¢.
Method of Determining Moisture Content of Wood—Forest Products Laboratory Technical Note No. B-11. Free.

Methods of Applying Wood Preservatives—Forest Products Laboratory Mimeo. No. R154. Free.
Millwork Catalog—California Redwood Association.
Modern Trends in Lumber Selling—I. N. Tate, Yale School of Forestry.
Montana Forest and Timber Handbook—Univ. of Montana.
National Directory of Commodity Specifications—Bureau of Standards, Supt. of Doc. $1.25.
National Lumber Handbook—National Lumber Manufacturers' Association.
Native Persimmon—Dept. Agriculture Farmers' Bulletin No. 685, Supt. of Doc. 5¢.
Naturally Durable California Redwood in Modern Timber Structures—California Redwood Association.
Naturally Durable California Redwood in Structural Grades with Safe Working Stresses—California Redwood Association.
Naval Stores Act and Regulations for Its Enforcement—Dept. Agriculture Misc. Cir. No. 22, Supt. of Doc. 5¢.
Naval Stores Industry—Dept. Agriculture Bulletin No. 229, Supt. of Doc. OP.
Norway Pine in the Lake States—Dept. Agriculture Bulletin No. 139, Supt. of Doc. OP.
Notes on the Manufacture of Plywood—Forest Products Laboratory Mimeo. No. 543. Free.
Notes on Wood Preservation and Utilization in Europe—American Wood Preservers' Association.
Oleoresin Production—Dept. Agriculture Bulletin No. 1064, Supt. of Doc. 20¢.
Operating Expenses of the Retail Lumber Yards in the Rocky Mountain Region—Business Bulletin No. 18, Univ. of Colo.
Pacific Flathead Borer—Dept. Agriculture Technical Bulletin No. 83, Supt. of Doc. 15¢.
Pacific Lumber Company Redwood Advertising—California Redwood Association.
Pandora Moth—A Periodic Pest of Western Pine Forests—Dept. Agriculture Technical Bulletin No. 137, Supt. of Doc. 5¢.
Permanent Inorganic Wood Preservatives—R. J. Howe, The Western Union Telegraph Company, New York, N. Y.
Piling Oak Dimension to Reduce Season Checks—Forest Products Laboratory Technical Note No. D-10. OP.
Plan of Organization and Operation for Arizona—New Mexico Lumber Manufacturers' Association—Associated Leaders of Lumber and Fuel Dealers of America.
Plan of Organization for City Retail Lumber Association—Associated Leaders of Lumber and Fuel Dealers of America.
Plan of Organization for Group Selling by Lumber Manufacturers—Associated Leaders of Lumber and Fuel Dealers of America.
Port Orford Cedar, Its Properties and Uses—Port Orford Cedar Products Company, Marshfield, Oregon.
Practical Kiln Drying—E. U. Kettle, American Lumberman.
Practical Lumbermen—Bernard Brereton, P. O. Box 355, Seattle, Wash.
Preservation of Mine Timbers—Dept. Agriculture Forest Service Bulletin No. 107, Supt. of Doc. 10¢.
Preservation of Structural Timber—Howard F. Weiss, McGraw.
Preservation—Wood—Numerous publications on this subject, listed in the chapter on "Wood Structure," are not duplicated in this General Bibliography.
Preservative Treatment of Farm Timbers—Dept. Agriculture Farmers' Bulletin No. 744, Supt. of Doc. 5¢.
Preventing Damage by Lyctus Powder-Post Beetles—Dept. Agriculture Farmers' Bulletin No. 1477, Supt. of Doc. 5¢.
Preventing Damage by Termites or White Ants—Dept. Agriculture Farmers' Bulletin No. 1472, Supt. of Doc. 5¢.
Prevention of Decay of Wood in Buildings—Forest Products Laboratory Mimeo. No. R82. Free.
Prevention of Sap Stain in Lumber—Dept. Agriculture Forest Service Cir. No. 192, Supt. of Doc. OP.
Principal Species of Wood—Their Characteristic Properties—Charles Henry Snow, Wiley.

Profitable Lumber Retailing—Associated Leaders of Lumber and Fuel Dealers of America.
Prolonging the Life of Cross-ties—Dept. Agriculture Forest Service Bulletin No. 118, Supt. of Doc. 15¢.
Prolonging the Life of Farm Timbers—New York State College of Forestry Cir. No. 34.
Properties and Uses of Douglas Fir—Dept. Agriculture Forest Service Bulletin No. 88, Supt. of Doc. 15¢.
Properties and Uses of Southern Pine—Dept. Agriculture Forest Service Cir. No. 164, Supt. of Doc. OP.
Properties and Uses of Wood—Koehler, McGraw.
Properties of Western Hemlock and Their Relations to Uses of the Wood—Dept. Agriculture Technical Bulletin No. 139, Supt. of Doc. 20¢.
Protection of Log Cabins, Rustic Work and Unseasoned Wood from Injurious Insects—Dept. Agriculture Farmers' Bulletin No. 1582, Supt. of Doc. 5¢.
Quantity of Wood Treated and Preservatives Used in the United States—American Wood Preservers' Association.
Quarter-sawed Oak Chair Posts at Plain-sawed Prices—Forest Products Laboratory Technical Note No. D-7. Free.
Rayon—A Brief Description of Processes of Manufacture—Bureau of Standards.
Ready Reference Inventory Book—American Lumberman.
Recent Installations of Zinc Chloride Treated Lumber—Grasselli Chemical Company, Cleveland, Ohio.
Red Alder of the Pacific Northwest—Dept. Agriculture Bulletin No. 1437, Supt. of Doc. 10¢.
Red Gum—Dept. Agriculture Forest Service Bulletin No. 58, Supt. of Doc. OP.
Red Spruce—Dept. Agriculture Bulletin No. 544, Supt. of Doc. 20¢.
Redwood Sales Manual—California Redwood Association.
References on Veneer and Veneer Products—Bureau of Foreign and Domestic Commerce, Dept. of Commerce, Washington, D. C.
Relation of Growth Factors to Wood Quality—White Ash—Benson H. Paul, Forest Products Laboratory. Free.
Relation of Treating Variables to the Penetration and Absorption of Preservatives into Wood—American Wood Preservers' Association.
Relative Resistance of Various Hardwoods to Injection with Creosote—Dept. Agriculture Bulletin No. 606, Supt. of Doc. OP.
Report on Seasoning, Handling, and Care of Lumber—National Committee on Wood Utilization, Supt. of Doc. Consumer's Edition, 15¢; Distributor's Edition, 20¢; Fabricator's Edition, 25¢; Manufacturer's Edition, 30¢.
Report on the Symposium of Termite Problems of the Termite Investigations Committee—Termite Investigations Committee, 215 Market Street, San Francisco, California.
Retail Lumber Dealer and How He Functions—F. H. Ludwig, Yale School of Forestry.
Sap Stains of Wood and Their Prevention—National Committee on Wood Utilization, Supt. of Doc. 35¢.
Sawdust and Wood Flour—National Committee on Wood Utilization, Supt. of Doc. 10¢.
Scientific Lumber Retailing—National Retail Lumber Dealer.
Seasoning and Preservation of Wood—E. G. Blake, Van Nostrand.
Seasoning and Preservative Treatment of Hemlock and Tamarack Cross-ties—Dept. Agriculture Forest Service Cir. No. 132, Supt. of Doc. 5¢.
Seasoning of Wood—Dept. Agriculture Bulletin No. 552, Supt. of Doc. 10¢.
Seasoning of Wood—Joseph B. Wagner, Van Nostrand.
Selling Black Walnut Timber—Dept. Agriculture Farmers' Bulletin No. 1459, Supt. of Doc. 5¢.
Short Account of the Big Trees of California—U. S. Division of Forestry Bulletin No. 28, Supt. of Doc. OP.
Shortleaf Pine Primer—Dept. Agriculture Farmers' Bulletin No. 1534, Supt. of Doc. 10¢.
Sitka Spruce—West Coast Lumbermen's Association.

Sitka Spruce—Its Uses, Growth and Management—Dept. Agriculture Bulletin No. 1060, Supt. of Doc. OP.

Sizes and Quantities of Rough Cuttings Required by Hardwood Consuming Industries—Forest Products Laboratory. OP.

Slash Pine—Dept. Agriculture Farmers' Bulletin No. 1256, Supt. of Doc. 5¢.

Small Dimension Stock—Numerous publications on this subject, listed in the chapter on "Lumber—Its Manufacture and Utilization," are not duplicated in this General Bibliography.

Southern Cypress—Dept. Agriculture Bulletin No. 272, Supt. of Doc. OP.

Southern Pine Beetle—Dept. Agriculture Farmers' Bulletin No. 1586, Supt. of Doc. 5¢.

Southern Pine Reference Book and Sales Manual—Southern Pine Association.

Southern Yellow Pine—Forest Products Laboratory Technical Note No. 214. Free.

Southern Yellow Pine Bridge and Trestle Timbers for Railway Structures—Southern Pine Association.

Southern Yellow Pine Car Material Specifications—Southern Pine Association.

Southern Yellow Pine Timbers—Southern Pine Association.

Specification Data for Structural Uses of Tidewater Red Cypress (Coast Type)—Southern Cypress Manufacturers' Association.

Spruce and Balsam Fir in the Rocky Mountains—Dept. Agriculture Forest Service Bulletin No. 327, Supt. of Doc. 20¢.

Standards and Specifications in the Wood Using Industries—Bureau of Standards, Supt. of Doc. $1.50.

Standard Molding Book—California Redwood Association.

Standard Terms for Describing Wood—Forest Products Laboratory Mimeo. No. 476. Free.

Statistical Bulletin No. 21—Dept. Agriculture Forest Service, Supt. of Doc. 45¢.

Stickering of Western Softwoods for Air Seasoning—Forest Products Laboratory Technical Note No. 219. Free.

Story of American Walnut—American Walnut Manufacturers' Association.

Story of Wood—National Lumber Manufacturers' Association.

Strength of North American Woods—Dept. Agriculture Misc. Pub. 46, Supt. of Doc. 5¢.

Strength of Southern Pine and Douglas Fir Compared—Forest Products Laboratory Technical Note No. 119. Free.

Study of Decay in Douglas Fir in the Pacific Northwest—Dept. Agriculture Bulletin No. 1163, Supt. of Doc. 10¢.

Sugar Pine—Dept. Agriculture Bulletin No. 426, Supt. of Doc. OP.

Sugar Pine and Western Yellow Pine in California—Dept. Agriculture Forest Service Bulletin No. 69, Supt. of Doc. OP.

Survey of Nonutilized Wood in North Carolina—National Committee on Wood Utilization, Supt. of Doc. 20¢.

Survey of Nonutilized Wood in Virginia—National Committee on Wood Utilization, Supt. of Doc. 20¢.

Swamp Cottonwood—Dept. Agriculture Forest Service Silvical Leaflet No. 40. OP.

Technical Notes—See Forest Products Laboratory.

Termites and Termite Damage—Agricultural Experiment Station Cir. No. 314, Univ. of Cal.

Termite Damage Prevention—National Lumber Manufacturers' Association.

Termites—Destroyers of Wood and Man's Fight Against Them—American Wood Preservers' Association.

Termites in Buildings—Dept. Agriculture Leaflet No. 31, Supt. of Doc. 5¢.

Tests of Methods of Protecting Woods Against Termites or White Ants—Dept. Agriculture Bulletin No. 1231, Supt. of Doc. 5¢.

Theory of Drying and Its Application to the New Humidity Regulated and Recirculating Dry Kiln—Dept. Agriculture Bulletin No. 509, Supt. of Doc. 5¢.

Timber, Its Strength, Seasoning and Grading—H. S. Betts, McGraw.

Timbers of Commerce—Herbert Stone, Rider.

Timbers of Tropical America—S. J. Record and C. D. Mell, Yale Univ. Press.

Trend of Wood Preserving Industry in the United States—American Wood Preservers' Association.
True Mahogany—Dept. Agriculture Bulletin No. 474, Supt. of Doc. 5¢.
Tupelo—Forest Service Leaflet—American Wood Series, Forest Service.
Turpentine and Rosin—Dept. Agriculture Cir. No. 258, Supt. of Doc. OP.
Turpentine—Its Source, Properties, Uses, Transportation, and Marketing with Recommended Specifications—Dept. Agriculture Bulletin No. 898, Supt. of Doc. 15¢.
U. S. Government Publications on Fungus Diseases of Trees—Forest Products Laboratory Mimeo. No. 508. Free.
Use of Southern Yellow Pine in Car Construction—Southern Pine Association.
Use of Wood in Chemical Apparatus—Forest Products Laboratory Mimeo. No. 512. Free.
Use of Wood for Fuel—Dept. Agriculture Bulletin No. 753, Supt. of Doc. OP.
Uses for Chestnut Timber Killed by the Bark Disease—Dept. Agriculture Farmers' Bulletin No. 582, Supt. of Doc. OP.
Uses of Bark for Paper Specialties—Forest Products Laboratory Mimeo. No. 889. Free.
Uses of Commercial Woods in the United States—Beeches, Birches and Maples—Dept. Agriculture Bulletin No. 12, Supt. of Doc. 10¢.
Uses of Commercial Woods in the United States—Cedars, Cypresses, Sequoias—Dept. Agriculture Forest Service Bulletin No. 95, Supt. of Doc. OP.
Utilization of Ash—Dept. Agriculture Bulletin No. 523, Supt. of Doc. 15¢.
Utilization of Basswood—Dept. Agriculture Bulletin No. 1007, Supt. of Doc. 20¢.
Utilization of Black Walnut—Dept. Agriculture Bulletin No. 909, Supt. of Doc. 30¢.
Utilization of Dogwood and Persimmon—Dept. Agriculture Bulletin No. 1436, Supt. of Doc. 15¢.
Utilization of Elm—Dept. Agriculture Bulletin No. 683, Supt. of Doc. 10¢.
Utilization of Sycamore—Dept. Agriculture Bulletin No. 884, Supt. of Doc. 5¢.
Utilization of Tupelo—Dept. Agriculture Forest Service Cir. No. 40, Supt. of Doc. OP.
Veneers and Plywood—Knight and Wulpi, Ronald.
Visual Method of Distinguishing Longleaf from Shortleaf and Loblolly Pine—Forest Products Laboratory Technical Note No. 141. Free.
Wall Boards and Insulating Boards—National Committee on Wood Utilization.
Weathering and Field Tests on Treated Wood—American Wood Preservers' Association.
Weights of Various Woods Grown in the United States—Forest Products Laboratory Technical Note No. 218. Free.
West Coast Woods, Douglas Fir, West Coast Hemlock, Western Red Cedar and Sitka Spruce—West Coast Lumbermen's Association.
Western Hemlock—Dept. Agriculture Forest Service Bulletin No. 33, Supt. of Doc. OP.
Western Red Cedar—Forest Service Leaflet—American Wood Series, Forest Service.
Western Yellow Pine Car Sills, Joists, and Small Clear Pieces—Dept. Agriculture Bulletin No. 497, Supt. of Doc. 5¢.
Western Yellow Pine in Arizona and New Mexico—Dept. Agriculture Forest Service Bulletin No. 101, Supt. of Doc. OP.
Western Yellow Pine in Oregon—Dept. Agriculture Forest Service Bulletin No. 418, Supt. of Doc. OP.
What is Meant by "Hardwoods" and "Softwoods"?—Forest Products Laboratory Technical Note No. 187. Free.
What Price Profits? Lumber Retailing—Associated Leaders of Lumber and Fuel Dealers of America.
White Oaks in the Southern Appalachians—Dept. Agriculture Forest Service Cir. No. 105, Supt. of Doc. OP.
White Pine—U. S. Forest Service Cir. No. 67. OP.
White Pines—Forest Products Laboratory Technical Note No. 215. Free.
White Water Utilization—Forest Products Laboratory. Free.
Wood Acids—Forest Products Laboratory Technical Note No. 155. Free.
Wood Burning Furnaces—Burrett O. Park, Am. Soc. of Mechanical Engineers.

Wood Construction Handbook for Architects, Engineers, and Builders—National Committee on Wood Utilization, McGraw.

Wood Distillation—L. F. Hawley, Chemical Catalog Co.

Wood Preservation Adapted to Present Day Needs of Lumber Users—American Lumber and Treating Corporation, 1138 Lake Shore Drive, Chicago, Ill.

Wood Preservation and the Forest Schools—American Wood Preservers' Association.

Wood Preservatives—Forest Products Laboratory Mimeo. No. R149. Free.

Wood Pulp Problem—National Committee on Wood Utilization.

Wood Tank and Vat—National Lumber Manufacturers' Association.

Wood Turpentines, Their Analysis, Refining and Composition—Dept. Agriculture Forest Service Bulletin No. 105, Supt. of Doc. 15¢.

Wood Used for Distillation in 1905—Dept. Agriculture Forest Service Cir. No. 50, Supt. of Doc. OP.

Wood Waste as Gas Producer Fuel—Forest Products Laboratory Mimeo. No. 117. Free.

Wood Waste Symposium—Forest Products Laboratory Mimeo. No. 80. OP.

Yields from Destructive Distillation of Certain Hardwoods—Dept. Agriculture Bulletin No. 508, Supt. of Doc. 5¢.

Yields of Alcohol from Wood Waste—Forest Products Laboratory Technical Note No. 120. Free.

Yellow Poplar—Dept. Agriculture Forest Service Cir. No. 93, Supt. of Doc. OP.

Yellow Poplar—Forest Service Leaflet—American Wood Series, Forest Service.

You Can Make It—National Committee on Wood Utilization, Supt. of Doc. 10¢.

Zinc Chloride for Mine Timber Preservation—Grasselli Chemical Company, Cleveland, Ohio.

Zinc Meta-Arsenite, A New Wood Preservative—Leo Patrick Curtin, Western Union Telegraph Company, New York, N. Y.

PUBLISHERS' ADDRESSES

(Addresses of periodicals, of lumber associations and of Governmental organizations will be found in the sections which list them and are not duplicated here.)

Am. Soc. of Mechanical Engineers—American Society of Mechanical Engineers, 29 West 39th Street, New York, N. Y.

Chemical Catalog Co.—Chemical Catalog Company, Inc., 419 Fourth Avenue, New York, N. Y.

Diary—Diary Publishing Company, 529 West 42d Street, New York, N. Y.

Dutton—E. P. Dutton & Company, Inc., 286 Fourth Avenue, New York, N. Y.

Lippincott—J. B. Lippincott Company, 227 East Washington Square, Philadelphia, Penn.

Macmillan—The Macmillan Company, 60 Fifth Avenue, New York, N. Y.

McGraw—McGraw-Hill Book Company, 370 Seventh Avenue, New York, N. Y.

N. Y. State College of Forestry—New York State College of Forestry, Syracuse University, Syracuse, New York.

Penrod—Penrod, Jurden and Clark Company, Cincinnati, Ohio.

Rider—Rider and Company, 34–36 Paternoster Row, London, EC4 England.

Ronald—Ronald Press Company, 15 East 26th Street, New York, N. Y.

Scientific Bk. Corp.—Scientific Book Corporation, 15 East 26th Street, New York, N. Y.

Supt. of Doc.—Superintendent of Documents, Government Printing Office, Washington, D. C.

(Remittances should be made by coupons, postal money order, express order, or New York draft. Foreign orders should be accompanied by international money order or New York draft. Remittance in currency will be at sender's risk. Postage stamps, coins defaced or worn smooth, foreign money, and uncertified checks will not be accepted.

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No charge is made for postage on documents forwarded to points in the United States, Alaska, Guam, Hawaii, Philippine Islands, Porto Rico, Samoa, or to Canada, Cuba, or Mexico. To other countries the regular rate of postage is charged.)

Complete list of price lists sent free on application

Univ. of Cal.—University of California, Berkeley, Cal.
Univ. of Colo.—University of Colorado, Boulder, Colo.
Univ. of Idaho—University of Idaho, Moscow, Idaho.
Univ. of Kan.—University of Kansas, Lawrence, Kan.
Univ. of Mont.—University of Montana, Missoula, Mont.
Univ. of Wash.—University of Washington Press, Seattle, Wash.
Van Nostrand—D. Van Nostrand Company, 250 Fourth Avenue, New York, N. Y.
Wiley—John Wiley & Sons, Inc., 440 Fourth Avenue, New York, N. Y.
Yale School of Forestry, 205 Prospect Street, New Haven, Conn.
Yale Univ. Press—Yale University Press, 143 Elm Street, New Haven, Conn.

DIRECTORIES

Abbey's Register, Western Lumber Industry—Industrial Service Company, Sherlock Building, Portland, Ore.

Blue Book, The Credit Rating Book—National Lumber Manufacturers Credit Corporation, Conway Building, Chicago, Ill.

Directory of American Sawmills and Planing Mills—Southern Lumbermen, Presbyterian Building, Nashville, Tenn.

Directory of Exporters of American Lumber—Bureau of Foreign and Domestic Commerce, Washington, D. C.

Directory of the Lumber Industry of the Pacific Coast—The Timberman, Spaulding Building, Portland, Ore.

McRae's Blue Book—McRae's Blue Book Company, 18 East Huron Street, Chicago, Ill.

Red Book—Lumberman's Credit Association, 608 South Dearborn Street, Chicago,Ill.

Sawmill Directory of the Six Southeastern States—The Southern Lumber Journal, 37 West Monroe Street, Jacksonville, Fla.

Southern Lumberman's Directory of American Lumber Consuming Factories—Southern Lumberman, Presbyterian Building, Nashville, Tenn.

Species of Lumber Manufactured—National Lumber Manufacturers Association, Transportation Building, Washington, D. C.

Thomas Register of American Manufacturers—Thomas Publishing Company, 461 Eighth Avenue, New York, N. Y.

West Coast Directory—West Coast Lumberman, 71 Columbia Street, Seattle, Wash.

GLOSSARY

Many terms in general use in the lumber industry are defined in dictionaries to be found in all libraries.

An extensive list of terms with their definitions is given in "Lumber—Its Manufacture and Distribution"—R. C. Bryant.

Technical Note No. 476—"Standard Terms for Describing Wood"—may be obtained free from the Forest Products Laboratory, Madison, Wisconsin.

All terms used in this book may be traced to their location by use of the index. Special interest should center around the index heading "NAMES" and the sub-headings under it.

Abbreviations are given on pages 477, 478, 479.

Various terms are defined in this book on the following pages:

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GOVERNMENTAL ORGANIZATIONS

Forest Service, U. S. Department of Agriculture, Washington, D. C.

The United States Forest Service had its beginning in 1881 in the Division of Forestry of the Department of Agriculture. This organization functioned until 1901, when it was designated as the Bureau of Forestry. It continued to expand until 1905, when it became known as the Forest Service.

The work of the Forest Service is divided into three principal lines of activity. First, the protection, administration, and development of the National Forests; second, research and technical investigations; and third, extension activities conducted in coöperation with state and private owners of timberlands for the furthering of better forestry practice and protection of forest lands.

The Forest Service also conducts investigations as to the best use of the forests and forest products of the country generally.

Forest Products Laboratory, U. S. Department of Agriculture, Madison, Wisconsin

The Forest Products Laboratory was established twenty years ago under the United States Department of Agriculture, as a research agency of the Forest Service. This Laboratory is maintained at Madison, Wisconsin, in coöperation with the University of Wisconsin, and is organized and geared together in specialized activities to handle the problems of wood utilization, from the growing tree through to the finished product in service. In scope, these projects cover a multitude of activities, ranging from studies of the physical and chemical properties of wood, pulp and paper investigations, and wood preservation, to intricate problems of wood finishing plants.

A staff of highly specialized technical men constantly develops improved processes and methods in the utilization of wood. Purchasing agents and consumers of any type of forest products are invited to submit wood-using problems to the Laboratory. The fundamental purpose of this organization is to secure maximum economy and efficiency in the production and utilization of forest products, for the Forest Service believes that the future of American Forest industry depends as much on the efficient use of wood as on the growing of more trees.

National Committee on Wood Utilization,[1] U. S. Department of Commerce, Washington, D. C.

The National Committee on Wood Utilization of the Department of Commerce was established by direction of President Coolidge in 1925. It was organized by Herbert Hoover, then Secretary of Commerce and first Chairman of the Committee.

It has for its aim the advancement of commercial reforestation through the more efficient and practical use of wood and forest products. The Committee, a coöperative

[1] *The National Committee on Wood Utilization—Its Accomplishments and Aims*, free upon application to the National Committee on Wood Utilization, Department of Commerce, Washington, D. C.

undertaking between government and industry, is composed of about two hundred producers, consumers, fabricators, distributors, and manufacturers of forest products. The Committee develops projects which deal specifically with a more efficient utilization of wood and forest products, specializing on studies of elimination of waste, the use of wood by-product "waste" materials, and the more profitable manufacture and distribution of forest products, all of which tend to increase the potential value of wood.

Bureau of Foreign and Domestic Commerce, U. S. Department of Commerce, Washington, D. C.

Among the numerous commodity divisions of the Bureau of Foreign and Domestic Commerce of the Department of Commerce is one which is of particular interest to lumber producers and consumers—the Lumber Division. The function of this Division is to supply assistance and information to the trade in lumber and wood products. Through foreign offices of the Bureau and American consuls data on markets for American lumber in foreign countries are secured. District Offices maintained by the Bureau supply foreign and domestic information to the trade throughout the United States. The Lumber Division—as well as other commodity divisions—is in charge of specialists thoroughly experienced in the handling of lumber trade problems and opportunities, both in domestic and export fields. The Lumber Division has issued numerous bulletins on foreign markets and has started a series on important American export species. Paper products and wood chemicals including naval stores are similarly handled by the Paper and the Chemical Divisions, and lumber-consuming industries by other commodity divisions.

Bureau of Standards, U. S. Department of Commerce,[1] Washington, D. C.

The work of the Bureau of Standards of the Department of Commerce needs no introduction. The Bureau's basic function is to establish and maintain the national standards of quantitative measurement. Further than this, it is a scientific and highly technical laboratory for service to the industries of the country and to the various departments of the Government.

In the Commercial Standards Unit, the Division of Simplified Practice has, with the coöperation of the lumber industry, established our present American Lumber Standards. This Division is particularly interested in the maintenance of such standards as are established in the lumber industry, in the eliminating of waste, and in establishing such further standards as can be developed practically by manufacturers, distributors, and consumers of forest products.

Bureau of the Census, U. S. Department of Commerce, Washington, D. C.

The Bureau of the Census is engaged in the compilation of statistics covering social, industrial, and fiscal inquiries. Of particular interest to the wood using industries and to consumers of forest products are data concerned with the production and consumption of forest products. These statistics include such items as production of lumber, lath, and shingles by states; consumption of pulpwood and production and consumption of wood pulp, by states; wood chemicals and derived products, etc.

These statistics are issued by the Bureau in the form of publications and are for sale by the Superintendent of Documents, Government Printing Office, Washington, D. C.

[1] *The U. S. Department of Commerce—Organization and Activities*, distributed free by the Division of Publications, Department of Commerce, Washington, D. C.

Smithsonian Institution, Washington, D. C.

The National Museum, a bureau under the supervision of the Smithsonian Institution at Washington, D. C., maintains among its many exhibits a comprehensive unit covering wood technology and utilization. The exhibit on wood is under the supervision of a trained forester and technologist. Included in this display is an excellent collection of native and tropical woods, together with examples of the manufacture of forest products, utilization of wood, etc.

In addition to the departments, bureaus, and divisions of the Federal Government, state forest associations, trade associations, and forestry schools and educational institutions offer valuable help in the utilization and economic use of wood and forest products. Constant research conducted by these agencies results in constructive data of special value to purchasing agents and other users of wood.

PERIODICALS

A few periodicals listed in various chapters, in which articles of value were published, will not be found here, as they have suspended publication. Files of them, however, may be found in the larger libraries. Annual subscription price for each magazine follows its address.

American Builder—105 West Adams Street, Chicago, Illinois—$2.
American Lumberman—431 South Dearborn Street, Chicago, Illinois—$4.
American Woodworking Review—Spalding Building, Portland, Oregon—$3.
Building Material Merchant—139 North Clark Street, Chicago, Illinois—Free
California Lumber Merchant—Central Building, Los Angeles, California—$2.
Crow's Pacific Coast Lumber Digest—American Bank Building, Portland, Oregon—$4.
Four L Lumber News—Concord Building, Portland, Oregon—$2.
Gulf Coast Lumberman—Second National Bank Building, Houston, Texas—$2.
Hardwood Buyers Guide and Wood Workers' Journal—400 W. Madison Street, Chicago, Ill.—$1.
Hardwood Record—537 South Dearborn Street, Chicago, Illinois—$2.
Industrial Woodworking—222 East Ohio Street, Indianapolis, Indiana—Free
Lumber Co-Operator—Temple Building, Rochester, New York—$1.
Lumbermen's Clearing House Buyers' Guide—Interstate Bank Building, New Orleans, Louisiana—Free
Lumber Trade Journal—606 Commercial Place, New Orleans, Louisiana—$3.
Lumber Worker—150 Fourth Avenue, Nashville, Tennessee—$1.
Memphis Lumberman and Southern Woodworker—Bank of Commerce Building, Memphis, Tennessee—$1.
Millwork—309 Montgomery Building, Milwaukee, Wisconsin—$3.
Mississippi Valley Lumberman—Lumber Exchange Building, Minneapolis, Minnesota—$3.50.
National Lumberman—249 West 39th Street, New York, New York—$1.
National Retail Lumber Dealer—Hearst Building, Chicago, Illinois—$1.
New York Lumber Trade Journal—285 Madison Avenue, New York, New York—$3.
Pennsylvania Lumberman—845 Prescott Avenue, Scranton, Pennsylvania—$1.25.
Retail Lumberman—1306 Locust Street, Kansas City, Missouri—$1.
Southern Lumber Journal—37 West Monroe Street, Jacksonville, Florida—$2.
Southern Lumberman—Presbyterian Building, Nashville, Tennessee—$5.
Timberman—Spalding Building, Portland, Oregon—$3.
Veneers—222 East Ohio Street, Indianapolis, Indiana—$1.
West Coast Lumberman—71 Columbia Street, Seattle, Washington—$3.
Western Retail Lumberman—Jones Building, Spokane, Washington—$1.
Western Wood Worker and Furniture Manufacturer—71 Columbia Street, Seattle, Washington—$3.
Wood Construction—Xenia, Ohio—$2.
Wood Preserving News—111 West Washington Street, Chicago, Illinois—Free
Wood-Worker—Wulsin Building, Indianapolis, Indiana—$2.
Wood Workers Clearing House Journal—431 South Dearborn Street, Chicago, Illinois—$1.
Wood Working Industries—4th at Clinton Street, Jamestown, New York—$1.

INDEX

INDEX

IMPORTANT—This index uses the NOUN as the basis for alphabetic sequence, following the noun with such adjectives as are essential. Thus, if you are looking for red gum, see Gum, red.

Exceptions have been made where duplicate entries have been thought advisable and both forms used. Local names of trees have not been entered in this form, but are given as found in the chapters on each species under the heading "Also called."

In line with the present trend towards simplification in industry the lumber industry is promoting standard names for commercial species. Such names may be found by reference to the word "Names" in this index, and under the heading "Usual names" in the chapters on each species.

Local custom, however, has given a wide variety of nonstandard names to many woods. Such names are still in some use, and are listed in each species chapter under the heading "Also called." Some names which are standard for one species are nonstandard for others.

*All names of woods occurring in this book are in this index. All nonstandard names are marked with an asterisk, thus *, even though the exact same word may be the standard name for some other species.*

When you find the asterisk (*) before a name in which you are interested—refer to the chapter in which it occurs, and there, under the heading "Usual Name," find the correct standard name for that species.

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